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CHARLES F. MARVIN, Chief

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AUGUST, 1917

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CONTENTS.

	Page.
INTRODUCTION	397
SECTION I.—AEROLOGY:	
Solar and sky radiation during August, 1917. H. H. Kimball	398
Aurora of August 21, 1917. D. F. Manning	399
Aurora of August 25, 1917, at Washington, D. C. I. F. Hand; C. Abbe, jr.	399
Parhelia 90° from the sun seen in Jamaica. Maxwell Hall. (Reprinted) (fig.)	399
Magnetic storm of August 26–27, 1916. W. E. W. Jackson. (Abstract)	400
Comparison of Callendar sunshine recorder and Ångstrom pyrheliometer. J. Patterson. (Abstract)	400
Penetrating radiation in the atmosphere. G. C. Simpson. (Abstract)	401
Meteorology and aviation. W. H. Dines. (Abstract)	401
SECTION II.—GENERAL METEOROLOGY:	
Predicting minimum temperatures. J. Warren Smith	402
Lowest air temperature at a meteorological station. B. Galitzin	407
Notes on the hot wave in southern California, June 14–17, 1917. Ford A. Carpenter. (5 figs.)	408
Changes in the Weather Bureau program of observations. (Abstract)	411
The Weather Bureau and the War. (Abstract)	411
Normal anomalies of mean annual temperature variation. H. Arctowski. (Abstract)	412
Structure of hailstones of exceptional form and size. F. E. Lloyd. (Abstract)	412
Improved methods in hygrometry. A. N. Shaw. (Abstract)	412
Factors influencing the condensation of aqueous vapor in the atmosphere. A. Masini. (Abstract)	412
Evaporation of mercury droplets suspended in a gas. A. Schidlof & A. Karpowicz. (Abstract)	413
Evaporation and absorption. A. Schidlof. (Abstract)	413
Dynamics of revolving fluids. Lord Rayleigh. (Abstract)	413
HENRY B. SCUDDER, 1844–1917. G. N. Salisbury	414
SECTION III.—FORECASTS:	
Forecasts and warnings for August, 1917. A. J. Henry. (Charts II and III)	415
SECTION III—FORECASTS—Continued.	
Quintette of cold waves in Florida. A. J. Mitchell (fig., Charts XLV—85–86)	416
SECTION IV.—RIVERS AND FLOODS:	
Rivers and floods during August, 1917. A. J. Henry. (Chart I)	418
Great Lakes levels during August, 1917	418
SECTION V.—SEISMOLOGY:	
Seismological reports for August, 1917. W. J. Humphreys	419
Late seismological reports	423
Seismological dispatches	425
SECTION VI.—BIBLIOGRAPHY:	
Recent additions to the Weather Bureau library. C. F. Talman	426
Recent papers bearing on meteorology and seismology. C. F. Talman	427
SECTION VII.—WEATHER AND DATA FOR THE MONTH:	
Weather of August, 1917. P. C. Day	428
Weather conditions over the North Atlantic during August, 1916 (with Chart IX)	429
Condensed climatological summary	431
Tables—	
Description	431
I. Climatological data for United States Weather Bureau stations	432
II. Accumulated amounts of precipitation	435
III. Data furnished by the Canadian Meteorological Service	438
Charts—	Charts.
I. Hydrographs, August, 1917	77
II. Tracks of centers of HIGHS	78
III. Tracks of centers of LOWS	79
IV. Departures of mean temperatures	80
V. Total precipitation for the month	81
VI. Percentage of clear sky	82
VII. Sealevel isobars and isotherms, and prevailing winds	83
VIII. Total snowfall for the month	Not charted.
IX. Marine meteorological data for August, 1916	84
A. J. M.—Fig. 1–4. Cold waves in Florida	85–86

NOTICE TO CONTRIBUTORS.

Contributions intended for publication in any given issue of the MONTHLY WEATHER REVIEW (e. g., January) should be in the hands of the editor before the end of the next following month (e. g., February), if no illustrations are required. When the paper is illustrated, the manuscript and the copy for illustrations must be submitted much earlier, in order to permit copy being prepared for the engraver by the end of the month.

REPRINTS are made up without covers in the original size and pagination of the REVIEW. They will not be furnished unless specifically REQUESTED WHEN THE MANUSCRIPT IS SUBMITTED.

MONTHLY WEATHER REVIEW

CLEVELAND ABBE, jr., Editor.

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INTRODUCTION.

As explained in this Introduction during 1914, the MONTHLY WEATHER REVIEW now takes the place of the Bulletin of the Mount Weather Observatory and of the voluminous publication of the climatological service of the Weather Bureau. The MONTHLY WEATHER REVIEW contains contributions from the research staff of the Weather Bureau and also special contributions of a general character in any branch of meteorology and climatology.

SUPPLEMENTS TO THE MONTHLY WEATHER REVIEW are published from time to time.

The climatological service of the Weather Bureau is maintained in all its essential features, but its publications, so far as they relate to purely local conditions, are incorporated in the monthly reports "Climatological Data" for the respective States, Territories, and colonies.

Beginning August, 1915, the material for the MONTHLY WEATHER REVIEW has been prepared and classified as follows:

SECTION 1.—*Aerology.*—Data and discussions relative to the free atmosphere.

SECTION 2.—*General meteorology.*—Special contributions by any competent student bearing on any branch of meteorology and climatology, theoretical or otherwise.

SECTION 3.—*Forecasts and general conditions of the atmosphere.*

SECTION 4.—*Rivers and floods.*

SECTION 5.—*Seismology.*—Results of observations by Weather Bureau observers and others as reported to the Washington office.

SECTION 6.—*Bibliography.*—Recent additions to the Weather Bureau library; recent papers bearing on meteorology.

SECTION 7.— *Weather of the month.*—Summary of local weather conditions; climatological data from regular Weather Bureau Statistics; tables of accumulated and excessive precipitation; data furnished by the Canadian Meteorological Service; monthly charts Nos. 1, 2, 3, 4, 5, 6, 7, 8, the same as hitherto; Meteorological Summary and chart No. 9 of the North Atlantic Ocean for this month in 1916. Owing to the fact that ocean meteorological data are frequently not available for a considerable time after the close of the month to which they relate, the chart and text matter in connection therewith appear one year late.

In general, appropriate officials prepare the seven sections above enumerated; but *all students of atmospherics are cordially invited to contribute such additional articles as seem to be of value.*

The voluminous tables of data and text relative to local climatological conditions, that during recent years were prepared by the 12 respective "district editors." are omitted from the MONTHLY WEATHER REVIEW, but collected and published by States at selected section centers in the monthly reports already mentioned.

The data needed in Section 7 can only be collected and prepared several weeks after the close of the month designated on the title-page; hence the REVIEW as a whole can only issue from the press within about eight weeks from the end of that month.

It is hoped that the meteorological data hitherto contributed by numerous independent services will continue as in the past. Our thanks are specially due to the directors and superintendents of the following:

The Meteorological Service of the Dominion of Canada.
The Meteorological Service of Cuba.
The Meteorological Observatory of Belén College, Habana.
The Government Meteorological Office of Jamaica.
The Meteorological Service of the Azores.
The Meteorological Office, London.
The Danish Meteorological Institute.
The Physical Central Observatory, Petrograd.
The Philippine Weather Bureau.

The Weather Bureau desires that the MONTHLY WEATHER REVIEW shall be a medium of publication for contributions within its field, but such publication is not to be construed as official approval of the views expressed.

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SECTION I.—AEROLOGY.

SOLAR AND SKY RADIATION MEASUREMENTS DURING AUGUST, 1917.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Washington, D. C., Sept. 29, 1917.]

For a description of instrumental exposures and an account of the methods of obtaining and reducing the measurements the reader is referred to the REVIEW for January, 1917, **45**:2.

The monthly means and departures from normal values given in Table 1 show that direct solar radiation averaged above normal intensity at all the stations. Noon intensities of 1.40 at Madison on the 25th and of 1.49 at Lincoln on the 10th exceed by about 1 per cent and 5 per cent, respectively, the previous maximum August noon intensities at those stations.

Table 3 shows a slight excess in the total radiation for the month at both Washington and Madison.

Skylight polarization measurements obtained at Washington on seven days give a mean of 50 per cent with a maximum of 56 per cent. These are average August values for Washington. The measurements obtained at Madison on 12 days give a mean of 66 per cent, with a maximum of 71 per cent on August 25.

TABLE 1.—*Solar radiation intensities during August, 1917.*

[Gram-calories per minute per square centimeter of normal surface.]

Washington, D. C.

Date.	Sun's zenith distance. 0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass. 1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Aug. 2	1.03	0.91	0.68	0.57	.....	.....	.....	.....	.....	.....
3	1.32	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	1.26	1.13	1.00	.....	.....	.....	.....	.....	.....	.....
6	1.05	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.37	1.14	0.97	0.86	0.78	.....	.....	.....	.....	.....
11	.....	.....	0.70	0.64	0.56	0.51	0.46	0.42	0.39	.....
17	1.28	0.91	0.65	.....	.....	.....	.....	.....	.....	.....
18	1.46	1.25	1.13	1.06	0.99	0.91	0.87	.....	.....	.....
20	.....	0.97	0.86	0.77	.....	.....	.....	.....	.....	.....
25	1.41	1.26	1.14	1.01	0.90	0.84	0.78	0.72	0.66	.....
26	.....	1.26	1.13	1.02	.....	.....	.....	.....	.....	.....
27	1.33	1.18	1.05	0.94	0.87	.....	.....	.....	.....	.....
28	1.22	1.13	1.01	0.89	0.79	0.71	.....	.....	.....	.....
Monthly means	**1.27**	**1.11**	**0.94**	**0.86**	**0.82**	**0.74**	**0.70**	**(0.57)**	**(0.52)**	.....
Departure from 9-year normal	**+0.03**	**+0.05**	**+0.05**	**+0.05**	**+0.08**	**+0.09**	**+0.15**	.....	.....	.....
P. M.										
Aug. 6	.....	0.91	0.75	.....	.....	.....	.....	.....	.....	.....
9	.....	1.15	0.95	0.78	0.65	.....	.....	.....	.....	.....
10	.....	1.16	0.79	0.70	0.64	0.60	0.57	.....	0.42	.....
18	.....	1.29	.....	.....	.....	.....	.....	.....	.....	.....
27	.....	1.18	1.08	0.98	0.91	0.81	.....	.....	0.70	0.64
Monthly means	.....	**1.14**	**0.89**	**0.82**	**0.73**	**(0.70)**	**(0.57)**	.....	**(0.56)**	**(0.64)**
Departure from 9-year normal	.....	**+0.05**	**+0.04**	**+0.01**	**+0.03**	**+0.08**	**+0.05**	.....	**+0.07**	.....

TABLE 1.—*Solar radiation intensities during August, 1917*—Continued

Madison, Wis.

Date.	Sun's zenith distance. 0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass. 1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Aug. 1	1.36	.....	.....	.....	.....	.....	.....	.....	.....	.....
2	.....	.....	1.17	1.11	1.04	0.98	0.93	0.89	.....	.....
3	1.35	.....	1.15	1.09	1.00	0.94	.....	.....	.....	.....
6	.....	.....	.....	.....	.....	0.96	.....	.....	.....	.....
10	1.40	1.27	1.16	1.11	1.04	0.98	0.92	0.87	0.82	.....
11	.....	.....	.....	.....	.....	0.93	0.84	.....	.....	.....
15	1.15	.....	.....	0.91	0.84	0.79	0.71	0.64	0.58	.....
17	1.40	1.22	1.09	1.02	0.97	.....	.....	.....	.....	.....
18	.....	.....	.....	.....	0.93	0.86	0.80	.....	.....	.....
19	.....	.....	1.08	1.01	.....	.....	.....	.....	.....	.....
20	1.23	1.03	0.85	0.74	0.65	0.59	0.53	.....	.....	.....
25	1.45	1.33	1.25	1.19	1.12	1.06	1.00	0.95	.....	.....
29	.....	.....	1.24	1.18	1.12	.....	1.00	0.95	.....	.....
30	.....	1.20	1.12	1.00	0.85	0.74	0.64	.....	.....	.....
31	.....	1.15	1.04	0.93	0.83	.....	.....	.....	.....	.....
Monthly means	**1.33**	**1.20**	**1.12**	**1.03**	**0.94**	**0.88**	**0.82**	**0.86**	**(0.70)**	.....
Departure from 7-year normal	**+0.02**	**+0.01**	**+0.03**	**+0.01**	**+0.02**	**−0.02**	**−0.01**	**+0.03**	.....	.....
P. M.										
Aug. 1	.....	1.28	1.20	1.11	.....	.....	.....	.....	.....	.....
15	.....	1.04	0.96	0.84	.....	.....	.....	.....	.....	.....
16	.....	1.24	1.16	1.09	0.99	0.96	0.89	0.84	.....	.....
17	.....	1.26	1.15	1.07	0.98	0.91	0.85	0.78	0.72	0.68
20	.....	1.17	.....	.....	.....	.....	.....	.....	.....	.....
30	.....	1.17	1.09	.....	.....	.....	.....	.....	.....	.....
31	.....	1.12	0.92	.....	.....	.....	.....	.....	.....	.....
Monthly means	.....	**1.18**	**1.08**	**1.03**	**(0.98)**	**(0.94)**	**(0.87)**	**(0.81)**	**(0.72)**	**(0.68)**
Departures from 7-year normal	.....	**+0.04**	**+0.06**	**+0.10**	**+0.16**	**+0.16**	**+0.08**	**+0.08**	**+0.16**	.....

Lincoln, Nebr.

A. M.										
Aug. 1	1.42	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	1.40	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	.....	1.27	1.16	1.07	1.02	0.95	0.86	.....	.....	.....
8	.....	1.22	1.14	1.00	.....	.....	.....	.....	.....	.....
9	1.51	1.40	1.34	1.26	1.20	1.13	1.06	0.98	.....	.....
10	1.53	1.36	1.24	1.18	1.12	1.02	0.97	0.91	.....	.....
13	.....	.....	1.06	.....	.....	0.96	0.94	0.89	0.84	.....
17	1.28	1.17	1.07	0.95	0.79	.....	.....	.....	.....	.....
18	.....	.....	0.88	0.75	0.65	.....	.....	.....	.....	.....
21	1.09	0.86	0.68	0.57	0.52	.....	.....	.....	.....	.....
22	1.25	1.18	1.05	0.93	0.81	0.72	.....	.....	.....	.....
23	1.49	1.39	1.35	1.25	1.13	1.10	1.01	0.94	0.90	.....
24	1.49	1.43	1.34	1.25	1.17	1.09	.....	.....	.....	.....
25	1.49	1.37	1.25	.....	1.03	.....	.....	0.70	0.64	.....
30	1.42	1.28	1.18	1.07	1.00	0.92	0.85	.....	.....	.....
31	1.29	.....	.....	.....	.....	.....	.....	.....	.....	.....
Monthly means	**1.39**	**1.27**	**1.13**	**1.03**	**0.95**	**0.99**	**0.95**	**0.88**	**0.79**	.....
Departures from 3-year normal	**+0.05**	**+0.08**	**+0.05**	**+0.04**	**+0.06**	**+0.14**	**+0.14**	**+0.14**	**+0.06**	.....
P. M.										
Aug. 3	.....	1.20	1.07	0.97	0.91	0.85	0.80	.....	.....	.....
9	.....	1.38	1.28	1.19	1.11	1.04	0.97	.....	0.83	0.77
10	.....	.....	1.21	.....	.....	.....	.....	.....	.....	.....
17	.....	1.13	.....	.....	.....	.....	.....	.....	.....	.....
22	.....	.....	0.99	0.87	0.74	0.65	.....	.....	.....	.....
23	.....	1.37	1.26	1.16	1.09	1.03	0.97	0.91	0.86	0.81
24	.....	1.36	1.27	1.19	1.11	1.04	0.98	0.93	0.89	0.84
Monthly means	.....	**1.29**	**1.18**	**1.08**	**0.99**	**0.92**	**0.93**	**(0.92)**	**0.86**	**0.81**
Departures from 3-year normal	.....	**+0.09**	**+0.08**	**+0.07**	**+0.07**	**+0.07**	**+0.16**	**+0.16**	**+0.12**	**+0.08**

TABLE 2.—*Vapor pressures at pyrheliometric stations on days when solar radiation intensities were measured.*

Washington, D. C.			Madison, Wis.			Lincoln, Nebr.		
Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.	Date.	8 a. m.	8 p. m.
1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*
Aug. 2	21.28	17.37	Aug. 1	16.79	10.21	Aug. 1	14.10	8.81
3	12.68	17.37	2	10.21	12.68	3	12.68	18.72
4	12.24	13.13	3	11.38	12.24	4	15.11	17.96
6	15.11	18.59	6	9.83	10.59	8	14.10	17.37
9	17.37	19.89	10	8.81	9.83	9	9.83	7.04
10	11.81	13.61	11	9.83	10.59	10	8.18	9.83
11	13.13	14.10	15	11.38	14.60	13	10.21	11.81
17	16.20	13.61	16	15.11	13.61	17	14.10	13.61
18	11.38	12.68	17	11.38	10.59	18	13.61	22.76
20	14.60	17.96	18	10.59	12.24	21	14.60	15.65
25	15.11	9.47	19	12.24	14.10	22	14.10	17.37
26	9.83	11.38	20	14.10	16.20	23	9.83	7.57
27	10.21	12.24	25	7.04	10.21	24	7.04	8.18
28	12.24	15.11	29	9.14	8.18	25	8.48	10.59
			30	9.14	8.81	30	8.18	8.18
			31	9.47	8.48	31	10.21	13.13

TABLE 3.—*Daily totals and departures of solar and sky radiation during August, 1917.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.		Departure from normal.		Excess or deficiency since first of month.	
	Washington.	Madison.	Washington.	Madison.	Washington.	Madison.
1917.	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*
Aug. 1	307	502	−179	24	−179	24
2	486	299	2	−176	−177	−152
3	533	597	52	124	−125	−28
4	611	535	132	65	7	37
5	614	499	138	31	145	68
6	560	529	86	64	231	132
7	415	272	−57	−191	174	−59
8	401	355	−68	−105	106	−164
9	520	402	53	−56	159	−220
10	609	637	144	182	303	−38
11	539	539	77	86	380	48
12	507	85	47	−365	427	−317
13	511	374	53	−74	480	−391
14	440	540	−15	95	465	−296
15	320	583	−133	140	332	−156
16	343	553	−108	112	224	−44
17	533	595	85	157	309	113
18	609	562	163	127	472	240
19	553	370	110	−62	582	178
20	531	546	90	116	672	294
Decade departure					+369	+332
21	515	303	77	−124	749	170
22	299	432	−137	8	612	178
23	128	428	−305	7	307	185
24	411	193	−20	−225	287	−40
25	516	607	88	192	375	152
26	584	554	158	142	533	294
27	579	161	156	−248	689	46
28	568	558	147	152	836	198
29	435	560	17	157	853	355
30	249	529	−167	129	686	484
31	102	540	−312	143	374	627
Decade departure					−298	+333
Excess or deficiency since first of year. gram-cal.					−4,540	+1,373
Excess or deficiency since first of year. per cent					−4.7	+1.4

AURORA OF AUGUST 21, 1917.

[Approved by Division of Aerological Investigations.]

Mr. Douglas F. Manning, Alexandria Bay, N. Y., contributes the following note of an aurora observed August 21, 1917:

On August 21, 1917, between the hours of 8 p. m. and midnight, and how much later I do not know, an aurora occurred of no particular brightness or well-defined formation, but of intense activity and at apparently a much lower altitude than any other display I have ever witnessed. The nearest description that could be given it would be to say that a display of sheet lightning was taking place without clouds, so tremendous was the speed of the yellow-greenish flashes of light that had their origin about 20° above the northern horizon, extending to about 5° south of the zenith whence they died out.

The sky was crystal clear, with a cool, brisk north wind blowing, and I regret that there were no clouds present so that I could [have formed] an estimation of the altitude of this aurora. The illusion of their presence in about the region occupied by the strato-cumulus was perfect; not only that, but the tremendous speed of the flashes with the ill-defined formation all seemd to prove that this aurora occurred at no very great height.

AURORA OF AUGUST 25, 1917, AT WASHINGTON, D. C.

American University (*Massachusetts and Nebraska Avenues*).—A brilliant display of the aurora borealis was observed at the American University from about 9 to 10 p. m. on August 25. When first observed (8:50 p. m.) it had the appearance of a bank of haze through which the beams of a searchlight might be shooting. It was soon apparent, however, that the display was an electrical one as streamers began shooting upward in rapid succession.

When at its maximum an arch 60° in length, 15° in height, 5° in width, was centered about the magnetic north the ends disappearing in a low bank of haze on the horizon. From this arch shooting upward were beautiful streamers of red and white. At about 9 p. m. (75th mer. time) a patch of brilliant red appeared about 15° east of north and directly above the arch. While similar patches were visible at the same and other points during the evening, this one far exceeded in brilliancy any of the others, appearing as a sky might from reflection of an intense fire.

At 9:10 p. m. a brilliant patch appeared directly above the lower left end of the arch. This had the form of a cirrus cloud, but was brilliantly colored with blue.

About 9:15 p. m. to 9:20 p. m. the streamers became varied in color, the white and red predominating. At 9:20 p. m. a secondary arch appeared about 5° above the first one, having the same distinct blue color of the lower arch.

The phenomenon ended shortly before 10 p. m.—*Irving F. Hand.*

Otterbourne, Chevy Chase (*Connecticut Avenue and Percy Street*).—Saturday night August 25, 1917, between 9:25 and 9:40 p. m. (75th meridian time), the undersigned observed from the point indicated in the margin, a characteristic auroral arch without any streamers. The arch was complete, about 10° high at its summit and had a horizontal extent of about 40° on the northern horizon. The summit seemed to be under Polaris. The light of the arch was a steady, pearly luminescence with a very slight suggestion of green. No dancing or pulsation was observed, although looked for. At about 9:30 there was, for a few seconds, a suggestion of a second and higher arch—or segment of one—forming about 1° above the center of the complete arch. Earlier and later observations could not be made owing to unfavorable location.—*C. Abbe, jr.*

PARHELIA 90° FROM THE SUN SEEN IN JAMAICA.[1]

By MAXWELL HALL.

[Montego Bay, Jamaica, May 1, 1917.]

On April 10, 1917, at about 8:40 a. m., local time, when the sun's altitude was about 40°, a most unusual phenomenon was seen by the Rev. G. E. Henderson and members of his family near Browns Town, namely, the parhelia or mock suns due to the intersection of the halo ring of 90° radius with the mock sun plane or ring parallel to the horizon.

Parhelia due to the intersection of the halo ring of 22° radius with the parhelic plane or ring are quite common; in the morning a sheet of thin cirro-stratus will often be

[1] *Reprinted from* Jamaica Weather Report No. 469, p. 5, on recommendation of Division of Aerological Investigations.

seen in Jamaica to produce that halo, and as often as not the halo is cut by the parhelic ring, producing two bright patches showing colored light on either side of the sun.

Parhelia may also be similarly formed with the halo ring of 46°; but parhelia formed with the halo ring of 90° have been seen only on a few occasions since the year 1663 when Hevelius, the astronomer, saw the phenomenon at Danzig; his drawing is reproduced in the Observer's Handbook, issued by the Meteorological Office, London.

Loomis in his Treatise on Meteorology, published in 1885, says that only three observations of this halo are on record, and that its exact dimensions have not been well determined.

No attempt was made on April 10 to measure anything, but there can be no doubt that the mock suns due to this halo and the parhelic ring were seen. Mr. Henderson wrote the same day to the Daily Gleaner, and to me on the 16th, and a few letters have been exchanged to settle the facts.

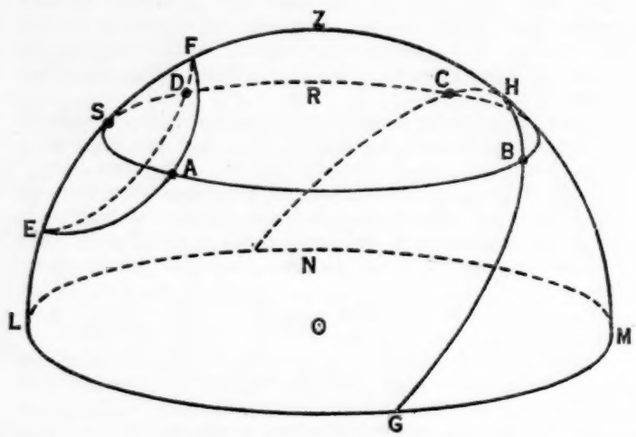

FIG. 1.—Perspective view of optical phenomenon at Browns Town, Jamaica, April 10, 1917.

At Browns Town there was much thin cirro-stratus about, indeed the sky seems to have been covered with it except to the north; the sun shone through it surrounded by a coronal ring of about 10° radius, and by the halo ring of 22° radius, both showing prismatic colors; the mock suns on either side of the sun, and at the same altitude as the sun, were almost of the same size and brilliancy as the sun itself.

As the sun was then nearly above the eastern point of the horizon, one of these mock-suns was about ENE, and the other ESE; the latter had a broad band of light extending about 10° along the parhelic ring, and away from the sun.

Following on round the horizon there was another mock sun in the SW and another in the NW, but these were both much fainter than the two towards the east. They were all about the same altitude above the horizon.

This unusual display lasted about half an hour, when a heavy cumulus cloud blotted it out.

In figure 1 *O* is the place of the observer and *L G M N* his horizontal plane; *S* is the sun, *E A F D* the halo ring of 22° radius and *G B H C* the halo ring of 90° radius; and *S A B C D* the parhelic or mock-sun ring; *A* and *D* are the two bright mock suns toward the east, and *B* and *C* are the two faint mock suns toward the west.

Now the latitude of the place is 18° 24′ N, the declination of the sun was 7° 52′ N, and the hour angle was about 50°; hence the azimuth of the sun was 85° from *N* toward *E*, the azimuth of *B* was 50° from *N* toward *W*, and the azimuth of *C* was 40° from *S* toward *W*; the latter azimuths agreeing with the observed positions NW and SW as nearly as could have been expected.

MAGNETIC STORM OF AUGUST 26-27, 1916.[1]

By W. E. W. JACKSON.

[*Reprinted from* Science Abstracts, Sect. A, June 25, 1917, §553.]

An analysis is made of the magnetic records at Sitka, Meanook, Agincourt, Cheltenham, Tucson, and Honolulu during the occurrence of the aurora and magnetic storm of August 26–27, 1916.

The beginning of the disturbance was very abrupt in H and D at all the stations, and from later comparisons with the records at Eskdalemuir it is evident that the effect occurred practically simultaneously all the world over.—*C. P. B[utler]*.

The Weather Bureau report on the aurora borealis of August 26–27, 1916, was published in this REVIEW, August, 1916, 44:440 and following.—C. A. jr.

COMPARISON OF CALLENDAR SUNSHINE RECORDER AND ÅNGSTRÖM PYRHELIOMETER.[2]

By J. PATTERSON.

[*Reprinted from* Science Abstracts, Sect. A, July 30, 1917, §584.]

Comparative readings were taken with (*a*) a normal Ångström pyrheliometer, (*b*) a similar instrument having the receiver covered with a glass bulb of the type used in the Callendar, and (*c*) a Callendar recorder. The results from one day's readings are shown graphically. These are typical of all days. The normal Ångström gives the highest readings. The shielded Ångström gives about 10 per cent lower throughout most of the day, but toward sunset this percentage error decreases. The Callendar recorder gives close agreement with the shielded Ångström in the morning, but during the afternoon the readings increase relatively and toward evening exceed those of the normal Ångström. In these experiments the Callendar was mounted normal to the incident sunlight and shielded from sky radiation. The comparisons which have been made with the Callendar show the desirability of standardizing its readings by laboratory investigation.—*J. S. Di[nes]*.

NOTE BY PROF. H. H. KIMBALL.

In connection with the observed afternoon excess of the shielded Ångström over the normal Ångström, one is reminded of Prof. Kimball's experience [3] to the effect that the Callendar instrument deprived of its glass screen read higher when the sun was low than when it was high. Further that the glass-screened Callendar read higher with a high morning sun than with a high afternoon sun.

Experiments also showed (loc. cit. Table 3) that with diminished intensity of solar radiation—artificially secured by means of a whirling sectored screen—the ratio of the Callendar instrument to the Marvin, *increased*.

All these experiences are in harmony with Patterson's results.

[1] Jour. Roy. Astron. Soc. Canada, Toronto, January, 1917, 11:17-22.
[2] Trans., Roy. Soc. Canada, Sept. 1916, 10:51-55.
[3] *Kimball, H. H.*, in this REVIEW, August, 1914, 42:475.

PENETRATING RADIATION IN THE ATMOSPHERE.[1]

By G. C. SIMPSON.

[*Reprinted from* Science Abstracts, Sect. A, June 25, 1917, §508.]

Experiments have demonstrated that the number of ions generated per cu. cm. per second in a hermetically sealed metal box increases rapidly with increase of height above the ground. This effect commences at about 2 kilometers and is continued up to 9 kilometers, the greatest height attained in the experiments. This can only be accounted for on the hypothesis of a far more penetrating radiation in the atmosphere than any previously known.[2] The source of this penetrating radiation has been the subject of speculation since its existence was established. E. von Schweidler finds that if the radiation were sent out from the sun the latter would have to possess a specific activity 170 times as great as that of pure uranium, a most improbable value. An alternative explanation that cosmical space is filled with a radioactive gas of a specific gravity 1/1200 that of uranium appears partially to account for the facts observed, though this explanation does not find favor with von Schweidler.

Linke has suggested a layer of strongly radioactive cosmical dust in the atmosphere at a height of 20 km. and puts forward several arguments in favor of this hypothesis. More observations are, however, required before this suggestion can be fully tested. Simpson pleads that mathematical physicists should take account of this new penetrating radiation, the existence of which is clearly demonstrated.—*J. S. Di*[*nes*].

[1] Nature, London, Apr. 12, 1917, 99:124–125.
[2] Science Abstracts, 1916, Sect. A, §1373; *See also* this REVIEW, March, 1916, 44:118.

METEOROLOGY AND AVIATION.

By W. H. DINES.

[*Condensed from* Nature, London, July 26, 1917, 99:424.]

After reviewing the various ways in which the elements hinder the evolutions of the aviator and the aeronaut, particularly he who would have to carry mails and passengers long distances,[1] Mr. Dines concludes as follows:

Thus it appears that the demand of the airman on the meteorologist is that he shall be able to forecast wind and fog, and to a less extent clouds, on the route the airman is proposing to follow. It has long been the business of the [London] Meteorological Office to forecast wind, and a certain amount of precision has been attained. During last winter Maj. Taylor investigated the possibilities of forecasting fog, and gave the results in lectures to the Royal Meteorological and Aeronautical Societies. His work constitutes a considerable advance investigation of this difficult subject. If we express the wind in terms of its two components, W. to E. and S. to N., the probable error of a forecast for each component is perhaps about 10 miles an hour, and there is not much prospect of improving this; the estimate is for England and the Continent, but farther south the conditions are much better.

I do not wish to emphasize the difficulties which lie in the way of regular air services, but they are there, and the first step toward overcoming them is to admit their existence.[2]

[1] See this REVIEW, June, 1917, 45: 270.
[2] Full text was reprinted in Sci. Amer. supplem., No. 2174, New York, Sept. 1, 1917, p. 144.

SECTION II.—GENERAL METEOROLOGY.

PREDICTING MINIMUM TEMPERATURES.[1]

By J. WARREN SMITH, Meteorologist in charge.

[Division of Agricultural Meteorology, Weather Bureau, July 2, 1917.]

With the development of orchard-heating methods and the protection of general fruit and garden crops from damage by frosts or low temperatures by heating, covering, or flooding, it becomes increasingly important that close predictions be made of the lowest temperatures that will probably be experienced in the immediate vicinity of the fruit buds or blossoms and garden truck.

The general predictions of light, heavy, or killing frosts for considerable areas are now accurately made from the morning weather map, and this information is being widely distributed by the Weather Bureau and made good use of by the people interested. During the critical period of fruit buds and blossoms and of early truck and garden crops, however, the men who are prepared to protect by heating or flooding wish a more definite statement of the probable minimum temperature, even though the information can reach them only a few hours in advance of its occurrence. This is particularly true in protecting cranberries by flooding because in order to properly flood the bogs the gates must be opened from two to six hours before the expected temperatures occur.

In an attempt to meet this demand for minimum temperature forecasts the writer, while in Ohio, made special use of two factors in making predictions in the evening for the minimum temperature on the following morning, and has since developed a third method. These are all for use on comparatively clear and still nights where there are wide local differences in temperature due to variations in topography. On cloudy or stormy nights or when strong winds prevail, accurate minimum temperature forecasts can be made only by a study of the daily weather maps.

PREDICTING MINIMUM TEMPERATURES ON CLEAR, STILL NIGHTS.

(1) *Predicting minimum temperatures by the usual or average fall in temperature on clear, still afternoons and evenings after the maximum temperature of the day is known.*—The temperature range from the maximum of one day to the minimum of the next morning is greatest in the valleys and least on the hillsides at the level of the so-called thermal belt or the stratum of warmest air of the temperature inversion that forms in valleys by the close of every clear, still night. It varies with different months, but is remarkably uniform under similar topographic conditions and at similar seasons of the year.

(2) *Predicting the minimum temperature from the median-temperature hour.*—This method was fully explained in the MONTHLY WEATHER REVIEW, October, 1914, **42**:581 and 582. In brief, it is based on the fact that the halfway temperature from the maximum of one day to the minimum of the following morning in comparatively still and clear weather occurs at about the same hour each evening. At Delaware, Ohio, during May, 1913, the average hour at which the halfway temperature occurred was 7:35 p. m.; and in May, 1914, it was 7:35 p. m. The earliest hour on any day in either of the two months was 7:15 p. m., and the latest was 7:50 p. m. This shows that at no time was the median-temperature hour more than 20 minutes from the average for the two successive years.

In determining the median-temperature hour it is necessary to keep a thermograph in operation for at least two years and to have the time factor carefully marked and the extreme records checked by means of accurate maximum and minimum thermometers. After the median-temperature hour has been determined, it is only necessary to read the temperature at this hour, subtract it from the maximum temperature of the day and then subtract this difference from the temperature prevailing at this hour. For example: if the highest temperature during the day is 68°F. and at 7:36 p. m., it has fallen to 50°, the difference, or 18 degrees, subtracted from 50° leaves 32° as the minimum temperature during the coming night. The average time of this median temperature, even under conditions of clear skies and still air, will vary slightly at different seasons of the year and in different localities.

In central Ohio, outside of the cities, the average time of the evening median will be at about 7:15 in April; 7:30 p. m. in May and June; 6:30 p. m. in September; and close to 6 p. m. in October and November. In July it is about 7:30 p. m. and in August 7 p. m. So far as we are able to determine it is not far from 6:30 p. m. in December; and 7 p. m. in January, February, and March, although our observations and studies are not very complete in the winter months.

If a strong wind is blowing in the afternoon or if it remains cloudy or partly cloudy until evening and then clears off, the time of the median will be from 30 to 45 minutes later than the average above given. If it should cloud up during the night after a clear afternoon and evening, the minimum will not be as low as indicated by the median. Records that are at hand indicate that the average time of the median will be slightly later in the valleys than at higher elevations. At Columbus, which represents a city station, the average time of the median is later than at Delaware, Ohio, and the variations between the earliest and latest hours is greater; but the error made by predicting the minimum from the average median is only slightly greater than at Delaware.

(3) *Predicting the minimum temperature from the dew-point and relative humidity in the late afternoon.*—Neglecting certain important considerations, it is often asserted that the minimum temperature during clear, still, nights should not be much lower than the evening dew-point temperature, but in actual practice there are found to be wide variations between these values. In the fruit-frost work in Ohio in 1914 it was found that at part of the fruit stations the minimum temperature on clear, still nights was always lower than the dewpoint of the evening before, and in some cases it was more than 20 degrees lower; at other stations the minimum varied from 10 degrees lower to 10 or more degrees higher than the evening dewpoint.

In the spring of 1915 an earnest effort was made to ascertain, if possible, under just what conditions of the atmosphere these variations occurred so that they might be anticipated. To accomplish this, observations were made at 12 different points in Ohio both morning and evening. The observations were made between 5 and 7 a. m. and 5 and 7 p. m. and covered the maximum and minimum temperatures, dry- and wet-bulb temperatures, wind direction and approximate velocity, rainfall, and

[1] A brief historical note by Prof. C. F. Marvin, appears at the end of this communication.

state of weather. Standard instruments were used, properly exposed, and in nearly every case the location was in the open country, where radiation conditions are good.

There were 28 nights in the spring of 1915 from March to June, inclusive, when the conditions were favorable for free radiation, and while all of the stations were not in operation throughout the entire period there were, at the 12 stations, a total of 222 cases when evening and morning observations were made when the night was clear and comparatively still. The records were carefully tabulated and checked, and I believe that the number of observations, the accuracy of the instruments, and the good exposure make the conclusions of marked value.

A careful study was made of the lowering of the dewpoint, the relation between the state of the weather and the depression of the minimum temperature below the evening dewpoint, and the relation between the relative humidity in the evening and morning without practical results.

THE AMOUNT OF MOISTURE IN THE ATMOSPHERE A MEASURE OF THE VARIATION OF THE MINIMUM TEMPERATURE FROM THE EVENING DEWPOINT.

It was found, however, that when there was a relatively high percentage of moisture in the atmosphere at the evening observation, the depression of the minimum temperature below the dewpoint was greater than when the moisture content was low. While this was shown in both the dewpoint and the relative humidity, the latter was used in discussing the matter. The evening relative humidity at each station on the nights under discussion was averaged, as well as the depression of the minimum below the dewpoint, and the results of the comparison for all the observations are shown in Table 1.

TABLE 1.—*Mean depression of the minimum temperature below the evening dewpoint, with stated variations of the relative humidity from the average.*

Relative humidity variations.	Number of cases.	Mean variation of minimum from dewpoint.
		°F.
More than 25 per cent above the average	6	−11.0
From 21 per cent to 25 per cent above the average	7	−8.0
From 16 per cent to 20 per cent above the average	13	−7.8
From 11 per cent to 15 per cent above the average	21	−6.5
From 6 per cent to 10 per cent above the average	25	−8.5
From 1 per cent to 5 per cent above the average	34	−5.8
From 0 per cent to 5 per cent below the average	41	−2.2
From 6 per cent to 10 per cent below the average	21	−1.9
From 11 per cent to 15 per cent below the average	25	−2.3
From 16 per cent to 20 per cent below the average	15	−0.2
From 21 per cent to 25 per cent below the average	7	+0.1
More than 25 per cent below the average	5	+4.8

This was further summarized and shown by Table 2.

TABLE 2.—*Table for estimating the variation between the evening dewpoint and the following minimum temperature, on comparatively clear still nights.*

When evening relative humidity is—	The minimum temperature will be—
More than 26 per cent below the average	5° higher than the dewpoint.
16 per cent to 25 per cent below the average	Just the same as the dewpoint.
0 per cent to 15 per cent below the average	2° lower than the dewpoint.
1 per cent to 15 per cent above the average	7° lower than the dewpoint.
16 per cent to 25 per cent above the average	8° lower than the dewpoint.
More than 25 per cent above the average	11° lower than the dewpoint.

In these calculations the average relative humidity is the average at each station in the spring of 1915 when radiation conditions prevailed. It varies for different stations from 53 to 74 per cent, and the variation from the average was obtained for each station separately. The average of all the stations is 64 per cent, therefore as a working basis Table 3 gives the approximate measure of the relation between the factors.

TABLE 3.—*Average relation between the evening relative humidity and the variation of the minimum temperature from the evening dewpoint.*

When evening relative humidity is—	The minimum will be—
Below 40 per cent	5° above the evening dewpoint.
From 40 per cent to 50 per cent	Close to the evening dewpoint.
From 50 per cent to 65 per cent	2° below the evening dewpoint.
From 65 per cent to 80 per cent	6° to 8° below the evening dewpoint.
Over 80 per cent	8° to 12° below the evening dewpoint.

It must be remembered that these values are averages and that there will be more or less variation from them, but they will enable one to make much closer minimum temperature forecasts than can be done by a consideration of the dewpoint alone.

Table 4 illustrates in detail the relation of these two factors at a few of the stations.

TABLE 4.—*Relation of the variation of the minimum temperature from the previous evening dewpoint to the evening relative humidity at five stations in 1915.*

Delaware, Ohio.		Germantown, Ohio.		Marietta, Ohio.		Warren, Ohio.		Wooster, Ohio.	
1	2	1	2	1	2	1	2	1	2
−12	10	−13	+20	−17	10	− 7	0	−13	11
−12	1	−12	14	−15	19	− 7	14	−13	32
−11	6	− 8	12	−15	10	− 7	15	−10	− 3
−11	22	− 7	14	−15	10	− 6	16	−10	10
−11	2	− 6	11	−14	24	− 5	19	− 9	13
− 9	5	− 5	0	−14	10	− 5	1	− 8	18
− 9	4	− 5	0	−10	16	− 3	14	− 7	23
− 9	4	− 4	− 1	− 9	0	− 4	15	− 7	5
− 9	2	− 4	0	− 9	−14	− 3	10	− 7	0
− 8	5	− 4	1	− 8	10	− 3	12	− 7	13
− 8	5	− 3	10	− 8	− 9	− 2	25	− 6	9
− 8	− 5	− 3	17	− 7	− 1	− 2	− 4	− 5	5
− 8	− 4	− 3	11	− 6	−17	0	−16	− 5	− 1
− 7	− 3	− 2	− 6	− 6	−13	0	−15	− 5	5
− 6	−11	− 1	0	− 6	− 5	0	−12	− 4	−13
− 6	− 3	− 1	− 4	− 6	−11	+ 1	13	− 4	− 9
− 5	−11	− 1	− 6	− 4	4	1	− 4	− 3	1
− 5	6	0	− 6	− 2	3	2	−19	− 3	−14
− 4	3	+ 1	−14	− 2	−21	2	5	− 1	1
− 4	7	2	− 9	+10	−23	2	11	− 1	− 3
− 3	− 1	2	− 2	.....	.....	3	−14	− 1	4
− 3	3	3	−16	.....	.....	3	− 2	− 1	−14
− 3	8	4	−18	.....	.....	3	−23	0	− 8
− 2	3	7	−23	.....	.....	13	−28	0	−14
− 2	−17	10	−15	.....	.....	.....	.....	+ 1	−11
− 2	− 5	.....	.....	.....	.....	.....	.....	4	− 8
− 1	− 8	.....	.....	.....	.....	.....	.....	5	−15
+ 1	−26	.....	.....	.....	.....	.....	.....	10	−19

Column **1** is the variation of the minimum temperature from the evening dewpoint. These figures are arranged so that the greatest depression below the dewpoint is shown at the top of each column and the date with the minimum temperature highest above the dewpoint at the bottom of the column.

Column **2** gives the variation of the evening relative humidity from the average. The dates are the same as in column 1, but the dates are not given because each station is independent of the others as regards dates.

An inspection of Table 4 shows at once that the relative humidity figures that are most above the average at that station are in the upper part of column 2, in connection with the figures in column 1 showing the greatest depression of the minimum temperature below the evening dewpoint, and that the low relative humidity values are

mostly at the bottom of the columns, where the minimum temperature is nearest to or even slightly above the evening dewpoint.

CORRELATION.

To show that there is a close relation between the two factors given in Table 4, the relative humidity as observed in the evening has been compared with the departure of the minimum temperature observed the following morning from the evening dewpoint at Germantown, Ohio, for those nights in the spring of 1915 when conditions favored radiation. This comparison is given in Table 5.

The method of correlation here employed is one of the more simple and has been used quite extensively by the author in the comparison of weather factors and crop yields.[2]

Prof. C. F. Marvin has published a discussion of the method in the MONTHLY WEATHER REVIEW, October, 1916, **44**:551–569. Therefore, it seems unnecessary to give here an extended discussion of the method.

In explanation of Table 5 it may be stated that column R gives the relative-humidity values, and that headed Y gives the difference between the morning minimum temperature and the dewpoint temperature of the preceding evening. The column x is the departure of the humidity values from the base number 53, and y is the departure of the values of Y from the base number -2; x^2 and y^2 explain themselves, as does also xy.

TABLE 5.—*Correlation of the relative humidity as observed in the evening, and the depression of the minimum temperature, recorded the following morning, from the evening dewpoint. Data for Germantown, Ohio, for those dates in the spring of 1915, when conditions favored radiation.*

Date.	Evening relative humidity.			Departure of morning minimum from preceding evening's dewpoint.			xy
	R	x	x^2	Y	y	y^2	
1915.	%			°F.			
Mar. 12	47	−6	36	0	2	4	−12
13	35	−18	324	4	6	36	−108
27	53	0	0	−1	1	1	0
Apr. 3	53	0	0	−5	−3	9	0
7	44	−9	81	2	4	16	−36
13	52	−1	1	−4	−2	4	2
18	30	−23	529	7	9	81	−207
24	51	−2	4	2	4	16	−8
25	63	10	100	−5	−3	9	−30
May 1	53	0	0	−4	−2	4	0
9	65	12	144	−8	−6	36	−72
10	47	−6	36	−2	0	0	0
22	67	14	196	−12	−10	100	−140
24	67	14	196	−7	−5	25	−70
June 4	75	20	400	−13	−11	121	−220
5	70	17	289	−3	−1	1	−17
9	53	0	0	−5	−3	9	0
15	64	11	121	−6	−4	16	−44
16	64	11	121	−3	−1	1	−11
17	54	1	1	−4	−2	4	−2
23	39	−14	196	1	3	9	−42
24	38	−15	225	10	12	144	−180
25	49	−4	16	−1	1	1	−4
26	47	−6	36	−1	1	1	−6
27	37	−16	256	3	5	25	−80
Sums (n=25)	1,315	−10	3,308	−55	−5	673	−1,287
Base Nos	53			−2			
Mean	52.6			−2.2			

[2] MONTHLY WEATHER REVIEW, May, 1911, **39**: 792-795; February, 1914, **42**: 78–93; May, 1915, **43**: 222–226.

Substituting the proper values in the following formulæ we get these results:

Standard deviation of relative humidity,

$$\sigma_x = \sqrt{\frac{[x^2] - \frac{[x]^2}{n}}{n}} = 11.50$$

Standard deviation of departure of minimum temperature from evening dewpoint,

$$\sigma_y = \sqrt{\frac{[y^2] - \frac{[y]^2}{n}}{n}} = 5.185$$

Coefficient of correlation,

$$r = \frac{[xy] - \frac{[x]\,[y]}{n}}{n\,\sigma_x\,\sigma_y} = -0.865$$

Probable error of correlation coefficient,

$$E_r = \pm 0.6745\,\frac{1 - r^2}{\sqrt{n}} = \pm 0.034$$

Therefore,

$$r = -0.865 \pm 0.034.$$

This high value for r indicates a close relation between the factors considered. The negative sign of the coefficient shows that when the relative humidity is high, the minimum temperature will fall the greatest amount below the dewpoint of the evening, and that when the relative humidity is low, the minimum temperature will be above the dewpoint by the greatest amount.

Similar data for 9 stations in Ohio, 6 stations in the Walla Walla district of Washington and Oregon, and for the cranberry station at Mather, Wis., were discussed in the same manner and corresponding correlation coefficients computed. The results are summarized in Table 6 hereunder.

TABLE 6.—*Correlation coefficients with corresponding probable error values for the stations in the Ohio district, and others; also coefficients for the Ohio district as a whole, and for the Walla Walla, Wash., district.*

Stations.	n	r	E_r
Clyde, Ohio	23	−0.429	±0.170
Germantown, Ohio	25	−0.865	±0.034
Green Hill, Ohio	28	−0.388	±0.160
Wooster, Ohio	28	−0.766	±0.078
Warren, Ohio	25	−0.694	±0.071
Roxabel, Ohio	11	−0.743	±0.135
Marietta, Ohio	20	−0.718	±0.108
Jackson, Ohio	26	−0.634	±0.117
Delaware, Ohio	28	−0.588	±0.124
OHIO	214	−0.635	±0.027
Walla Walla, Wash	24	−0.481	±0.104
Kennewick, Wash	24	−0.443	±0.164
Blalock, Wash	18	−0.647	±0.137
Gardena, Wash	19	−0.772	±0.092
Hermiston, Oreg	17	−0.494	±0.183
Milton, Oreg	21	−0.445	±0.175
WASHINGTON AND OREGON	123	−0.478	±0.047
Mather, Wis	23	−0.511	±0.104
For all 16 stations	360	−0.552	±0.025

The correlation coefficient shows a high value, with few exceptions, and strongly indicates a linear relation existing between the two factors considered. The mean

correlation coefficient for the 360 observations, embracing all 16 stations, is -0.552 ± 0.025, so that r is here about 28 times as great as E_r.

METHOD OF LEAST SQUARES.

While the above correlations show a close relation between the factors, the practical use of the information can probably be best obtained by a linear equation developed by the method of least squares.

TABLE 7.—*Evening relative humidity, R, and the variation of the minimum temperature of the following morning from the evening dewpoint, Y, at Germantown, Ohio, for those dates in the spring of 1915 when conditions favored radiation.*

Dates.	R	Y	R^2	RY
1915.	%	°F.		
Mar. 12	47	0	2,209	0
13	35	+ 4	1,225	+140
27	53	− 1	2,809	− 53
Apr. 3	53	− 5	2,809	−265
7	44	+ 2	1,936	+ 88
13	52	− 4	2,704	−208
18	30	+ 7	900	+210
24	51	+ 2	2,601	+102
25	63	− 5	3,969	−315
May 1	53	− 4	2,809	−212
9	65	− 8	4,225	−520
10	47	− 2	2,209	− 94
22	67	−12	4,489	−804
24	67	− 7	4,489	−469
June 4	73	−13	5,329	−949
5	70	− 3	4,900	−210
9	53	− 5	2,809	−265
15	64	− 6	4,096	−384
16	64	− 3	4,096	−192
17	54	− 4	2,916	−216
23	39	+ 1	1,521	+ 39
24	38	+10	1,444	+380
25	49	− 1	2,401	− 49
26	47	− 1	2,209	− 47
27	37	+ 3	1,369	+111
Sums (25=n)	$1,315 = \Sigma R$	$-55 = \Sigma Y$	$72,473 = \Sigma R^2$	$-4,182 = \Sigma RY$

In Table 7 the method of least squares as explained by Prof. C. F. Marvin in the MONTHLY WEATHER REVIEW (loc. cit.), is employed to determine the relation between the relative humidity of the evening and the minimum temperature of the following morning. Therefore, all that seems necessary in explanation of this table is to repeat the formulæ for obtaining the values of a and b, in the general equation

$$y = a + br$$

which here may be written

$$Y = a + bR. \qquad (1)$$

$$b = \frac{n(\Sigma RY) - (\Sigma R)(\Sigma Y)}{n(\Sigma R^2) - (\Sigma R)^2} = -0.39$$

$$a = \frac{\Sigma Y - b(\Sigma R)}{n} = 18.314$$

therefore,

$$y = Y = a + bR = 18.314 - 0.39R.$$

Since R is the relative humidity in the evening, and Y is the departure of the minimum temperature the following morning from the evening dewpoint, it becomes a simple matter to insert the value for R and to compute the value for Y, which becomes the probable departure of the minimum temperature to be expected the following morning from the evening dewpoint. As an example of the application of formula (1) let us substitute for R the relative humidity as observed on the evening of March 12 given in Table 7. The formula now becomes:

$$Y = 18.314 - 0.39 \times 47 = -0.02$$

which indicates that there will be practically no difference between the dewpoint, 23°F., observed on the evening of March 12, and the minimum temperature recorded on the morning of March 13. The temperature actually recorded was 23°F.

Again for the case of May 1, we substitute the value of the evening relative humidity, 50%, in the formula and now get this result:

$$Y = 18.314 - 0.39 \times 53 = -2.4,$$

indicating that the minimum temperature on the morning of May 2 should be 2.4 degrees lower than the dewpoint on the evening of May 1, or 39.6°. The actual temperature recorded was 38° F., or within 1.6 degrees of the estimate.

There is no instance in Table 7 where the value of Y as obtained from the formula varies more than 6 degrees from the actual or recorded value, and a careful investigation would probably reveal other factors not considered that caused the discrepancy, when the variation was so great.

TABLE 8.—*Evening relative humidity, R, and the variation of the minimum temperature of the following morning from the evening dewpoint, Y, at Delaware, Ohio, for those dates in the spring of 1915, when conditions favored radiation.*

Dates.	R	Y	R^2	RY
1915.	%	°F		
Mar. 12	67	− 3	4,489	−201
13	71	− 2	5,041	−142
27	71	− 3	5,041	−213
Apr. 3	57	− 5	3,249	−285
7	65	− 6	4,225	−390
13	57	− 5	3,249	−285
14	51	− 2	2,601	−102
17	42	1	1,764	+ 42
18	60	− 1	3,600	− 60
24	73	− 8	5,329	−584
25	73	− 8	5,329	−584
May 1	74	− 5	5,476	−370
5	60	− 3	3,600	−180
9	73	− 9	5,329	−657
10	65	− 7	4,225	−455
22	78	−12	6,084	−936
24	74	−11	5,476	−814
June 4	90	−11	8,100	−990
5	73	− 2	5,329	−146
9	72	− 9	5,184	−648
15	63	− 8	3,969	−504
16	72	− 9	5,184	−648
17	70	− 9	4,900	−630
23	69	−12	4,761	−828
24	71	− 4	5,041	−284
25	75	− 4	5,625	−300
26	64	− 8	4,096	−512
27	70	−11	4,900	−770
Sums (28=n)	$1,900 = \Sigma R$	$-176 = \Sigma Y$	$131,196 = \Sigma R^2$	$-12,476 = \Sigma RY$

A similar discussion of the observations at Delaware, Ohio, is presented in Table 8. The value of b is found to be -0.235, and of a to be 9.66. The equation for Delaware then becomes:

$$Y = 9.66 - 0.235R$$

Application of this equation to each date in the spring of 1915 when conditions favored radiation at Delaware, Ohio, showed that in no instance did the computed minimum temperature vary from the actual by more than 5 degrees. As stated in connection with Germantown and Table 7, it is possible that a more careful in-

vestigation of these dates when the variation was so great would reveal other contributing factors that have not been taken into account.

There arise the questions (1) whether one may not determine for a and b values that will be constant and applicable to all stations; (2) whether the equation for one station may be applied to another with favorable results. If such is the case, by substituting a constant value for R in each equation, the resultant values for Y should be identical. This was done, 50 being used as the constant R. In Table 9 is given the resulting values for Y whose dissimilarities indicate that these stations present an individual problem in each case. However, it is believed that further study over a longer period of time will establish equations applicable to stations with similar topographic surroundings, and at the same season of the year.

TABLE 9.—*Values of a and b at various stations, and values of Y, determined by using 50 per cent as a constant value for R in equation (1).*

Station.	a	b	Y
Clyde, Ohio	10.149	−0.189	+0.7
Germantown, Ohio	18.314	−0.39	−1.2
Green Hill, Ohio	0.675	−0.108	−4.7
Wooster, Ohio	14.175	−0.289	−0.3
Warren, Ohio	12.786	−0.231	+1.2
Roxabel, Ohio	17.573	−0.261	+2.5
Marietta, Ohio	12.135	−0.332	−4.5
Jackson, Ohio	5.37	−0.196	−4.4
Delaware, Ohio	9.66	−0.235	−2.1
Walla Walla, Wash	12.365	−0.221	+1.3
Kennewick, Wash	9.555	−0.246	−2.7
Gardena, Wash	1.862	−0.071	−1.7
Blalock, Wash	22.615	−0.484	−1.6
Hermiston, Oreg	20.763	−0.573	−7.9
Milton, Oreg	11.816	−0.226	+0.5
Mather, Wis	9.899	−0.226	−1.4

The values of a and b in this table may be of benefit to any who are interested in carrying this subject farther, and who are interested in the hygrometric method of temperature estimates.

Comparison of the hygrometric equation, the night temperature range, and these two in combination.—Recognizing that this hygrometric equation, as developed by the method of least squares, may have its limitations and that too much weight should not be given its use—at least during these experimental stages—a comparison of the results obtained by its use, with those secured by the use of the night temperature range, and by an average between the two methods was made. The comparison appears in Table 10, which checks the computed against the actually recorded minima.

It will be noted of the 25 cases, that in 20 of them the computed minimum was within 3 degrees of the minimum recorded, using the hygrometric method; 13 times as estimated by the night-temperature-range method; and 21 times by the average of the two. Twice the minimum estimated by the hygrometric equation was 6 degrees too low, and once 4 degrees too high. Three times by the night-range method it was 6 degrees too low, and once 7 degrees too high. Twice by the average of the two it was 6 degrees too low and once 5 degrees too high.

It is interesting to note that there is a marked agreement between the minimum estimated by the hygrometric equation and the actual on those dates when frost temperatures occurred, and that the greater departures occurred when the temperature to be expected was not of so much economic importance. This was not true in the temperature-range method.[3]

[3] The agreement here remarked is probably an accidental one.—*C. F. Marvin.*

TABLE 10.—*Minimum temperature estimates for Germantown, Ohio, when conditions favored radiation, using hygrometric method, night-temperature range, and a combination of both, with corresponding errors.*

Dates.	Minimum recorded.	Computed by aid of equation $Y=a+bR$	Error by this method.	Computed by the night-temperature-range method.	Error by this method.	Estimated from mean of first two methods.	Error by this method.
1915.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Mar. 13	23	23	0	18	−5	20	−3
14	26	27	+1	24	−2	26	0
28	24	23	−1	18	−6	20	−4
Apr. 4	20	23	+3	16	−4	20	0
8	40	39	−1	39	−1	39	−1
14	31	33	+2	28	−3	30	−1
19	44	45	+1	48	+4	46	+2
25	56	52	−4	59	+3	56	0
26	57	56	−1	60	+3	58	+1
May 2	38	40	+2	34	−4	37	−1
10	34	35	+1	39	+5	37	+3
11	40	42	+2	41	+1	42	+2
23	45	49	+4	52	+7	50	+5
25	49	48	−1	50	+1	49	0
June 5	50	53	+3	46	−4	50	0
6	61	55	−6	55	−6	55	−6
10	43	46	+3	43	0	44	+1
16	50	49	−1	51	+1	50	0
17	55	51	−4	54	−1	52	−3
18	57	58	+1	57	0	58	+1
24	43	45	+2	47	+4	46	+3
25	59	53	−6	53	−6	53	−6
26	55	55	0	57	+2	56	+1
27	57	58	+1	58	+1	58	+1
28	54	55	+1	59	+5	57	+3

Table 11 presents, for Delaware, Ohio, a similar comparison of the preceding methods, but adds that of the median-temperature hour. In this table the minimum estimated from the mean of the three methods, hygrometric, night-temperature range, and median-hour, is given in the last two columns.

TABLE 11.—*Minimum temperature estimates for Delaware, Ohio, on dates in spring of 1915 when conditions favored radiation, using hygrometric, night-temperature-range, median-temperature-hour methods, and the mean of these three.*

Dates.	Minimum recorded.	Computed by aid of equation $Y=a+bR$	Error by this method.	Computed by the night-temperature-range method.	Error by this method.	Computed by the median-temperature-hour method.	Error by this method.	Estimated from mean of first three methods.	Error by this method.
1915.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Mar. 13	17	14	−3	13	−4	15	−2	14	−3
14	23	18	−5	20	−3	22	−1	20	−3
28	22	18	−4	14	−8	20	−2	17	−5
Apr. 4	16	17	+1	12	−4	20	+4	16	0
8	28	28	0	33	+5	29	+1	30	+2
14	25	26	+1	27	+2	31	+6	28	+3
15	25	25	0	31	+6	31	+6	29	+4
18	28	27	−1	34	+6	30	+2	30	+2
19	40	37	−3	44	+4	37	−3	39	−1
25	54	55	+1	58	+4	58	+4	57	+3
26	55	56	+1	62	+7	54	−1	57	+2
May 2	36	33	−3	38	+2	35	−1	35	−1
6	38	37	−1	33	−5	40*	+2	37	−1
10	31	33	+2	27	−4	.....	.....	30†	−1
11	35	36	+1	40	+5	34	−1	37	+2
23	41	44	+3	45	+4	43*	+2	44	+3
25	44	47	+3	45	+1	47	+3	46	+2
June 5	52	52	0	43	−9	56*	+4	50	−2
6	49	44	+5	54	+5	49	0	49	0
10	39	41	+2	41	+2	43	+4	42	+3
16	47	50	+3	48	+1	.....	.....	49†	+2
17	52	54	+2	51	−1	55	+3	53	+1
18	56	58	+2	56	0	60	+4	58	+2
24	40	45	+5	41	+1	44	+4	43	+3
25	52	49	−3	51	−1	51	−1	50	−2
26	58	54	−4	56	−2	56	−2	55	−3
27	49	52	+3	52	+3	52	+3	52	+3
28	53	57	+4	55	+2	53	0	55	+2

*Allowance made for clouded sky on preceding afternoon by projecting thermograph trace upward.

† Average of two estimates only.

It will be noted that at Delaware the estimated minimum by the hygrometric method was within 3 degrees of the actual 22 times out of the 28 cases, and was 5 degrees too low twice and 5 degrees too high once. Using the temperature-range method, the estimate was within 3 degrees of the actual 13 times out of the 28 cases, was once 9 degrees too low, and once 7 degrees too high. In 26 cases using the median-temperature method, 18 times the estimated was within 3 degrees of the actual, twice being 6 degrees too high, and once 3 degrees too low. By using the mean of these three computations we find that in the 28 cases considered the computed was within 3 degrees of the actual 26 times, and that it was once 5 degrees too low and once 4 degrees too high.

CONCLUSIONS.

It seems probable that formulæ may be prepared by two years' thermograph records and whirled psychrometer observations that will permit the making of very accurate minimum temperature forecasts under radiation conditions at any specified point, and further that longer carefully made records will permit of establishing rules that will be widely applicable to places under similar topographic and atmospheric surroundings. The method of hygrometric equation has an advantage in the fact that the dewpoint and relative humidity observations may apparently be made at any convenient hour in the late afternoon or early evening. After the observations have been reduced, and the values of a and b determined, it is then very easy to determine the variation of the minimum temperature from the evening dewpoint by the formula

$$Y = a + bR$$

in which R is the relative humidity at the evening observation and Y the probable variation of the minimum temperature from the evening dewpoint.

HISTORICAL NOTE.

By CHARLES F. MARVIN, Chief of Bureau.

The subject matter of this paper, as regards the prediction of minimum temperatures by means of the so-called median temperature and also the method based on the evening dewpoint and relative humidity, was fully presented by Prof. Smith in a paper submitted August 14, 1915. Publication was deferred at that time because of scantiness of certain data bearing on the question of the change in dewpoint throughout the night, and from other considerations. This lack of data has since been removed and the conclusions of the original paper are herein now seen to be fully confirmed.

Attention is called to the circumstance that as early as 1910 Charles A. Donnel, in analyzing certain special observations made at Boise under the direction of Edward L. Wells, for the purpose of predicting minimum temperatures, noticed that when the evening relative humidity was about 55 per cent, the minimum temperature was about the same as the evening dewpoint. Subsequently, Mr. Wells in a personal report to Mr. Beals, at Portland, Oreg., dated August 9, 1912, stated the relation Donnel had pointed out in the following equation:

M = expected minimum temperature, at orchard level.
D = dewpoint at 8 p. m., at orchard level.
R = relative humidity, at 8 p. m., at orchard level.

Then,

$$M = D - \frac{R-45}{5}$$

This matter was briefly alluded to by Mr. Beals in his bulletin "Forecasting Frost in the North Pacific States," page 17.[4]

During 1917 Floyd D. Young, detailed from the Portland, Oreg., station to manage the spring frost warning service at Medford, Oreg., reported at some length on his utilization of the Donnel relation in that work. Mr. W. G. Reed, also engaged in frost protection investigations at Medford, Oreg., and familiar in a general way with Prof. Smith's investigations, has also studied the utility and application of this relation between the evening hygrometric state and the minimum temperature of the following morning.

It is interesting to observe the close similarity between the entirely independent investigations of Donnel and Wells on the one hand and Prof. Smith on the other. The mathematical identity of the two equations employed is easily shown.

Let M = morning minimum temperature.
Let D = evening dewpoint and R = relative humidity.

DONNEL.	SMITH.
$M = D - \frac{R-n_1}{n_2}$	Y = difference between minimum and dewpoint = $M-D$.
in which n_1, n_2 are two numbers deduced from study of data.	R = evening rel. humidity. a and b are two constants depending on the data.
$M-D = \frac{n_1}{n_2} - \frac{1}{n_2}R$	$Y = a - bR$.
Let $M-D = Y$, $\frac{n_1}{n_2} = a$, $\frac{1}{n_2} = b$.	The computations show that the values of b are negative.
$\therefore Y = a - bR$	

THE LOWEST AIR TEMPERATURE AT A METEOROLOGICAL STATION.

While works on meteorology generally agree in stating that the lowest temperature ever observed at a meteorological station (not including upper-air observations) was recorded at Verkhoyansk, Siberia, the value of the reading and the date of occurrence have been variously stated. The following letter on this subject is in reply to one addressed to the late Prince Boris Galitzin (Russian, Golitsyn), director of the Nicholas Central Physical Observatory, Petrograd. The reference in the last paragraph is to Prof. A. Voeĭkov's "Meteorologia," St. Petersburg, 1910, p. 73, where the absolute minimum at Verkhoyansk is given as −72°C.—*C. F. Talman, Librarian.*

OBSERVATOIRE PHYSIQUE CENTRAL NICOLAS,
Petrograd, Dec. 2, 1915.

Prof. C. F. MARVIN,
Chief Weather Bureau,
Washington, D. C.

DEAR SIR: In answer to your letter [of] October 4, 1915, about the lowest temperature of air in Verkhoyansk, I can refer you to what follows:

The lowest temperature was noticed by the observer at Verkhoyansk the 5th and 7th of February, 1892. The observations were made by means of the alcohol thermometer Müller No. 81*: the direct reading on this thermometer was −68° C. [= −90.4° F.]. This thermometer, No. 81*, was verified in the Central Physical Observatory, but only

[4] *Beals, E. A.* Forecasting frost in the North Pacific States. Washington, 1912. [12 figs.], 49 p. 8°. (Weather Bureau Bull. 41.) (W. B. No. 473.)

between the limits +20° and −20°, so that we don't possess its corrections for lower temperatures.

In order to reduce the alcohol thermometers to the terms of the international hydrogen thermometer, to all readings made on alcohol thermometers, before their being published in the Annals for 1892, corrections were applied, as they were obtained by Mr. Hlasek from comparisons of the thermometer, Geissler No. A, belonging to the Observatory, with the normal thermometer Tonnelot, purchased by the Observatory and verified in the International Bureau of Weights and Measures. The corrections were—

At.....	−20° C.	−30° C.	−40° C.	−50° C.	−60°C.
Correction	0.0°	−0.6°	−1.1°	−1.6°	−2.0°

From direct comparisons of the readings of the alcohol thermometers with those of the mercury ones, made at several stations in the district of the Observatory in the interval −30° to −40° it follows, that these corrections ought not have been applied to the alcohol thermometers on most stations, for the readings of the alcohol thermometers differ in the above-mentioned interval in general very little from the readings of the mercury thermometers.

Therefore since 1893 the above-stated corrections were no more applied to the readings of the alcohol thermometers and for low temperatures only additional corrections were used, obtained from direct comparisons of the alcohol thermometers with the mercury ones, belonging to the stations.

Owing to these reasons I suppose, that the correction −2.0° C. should not have been applied to the readings of the alcohol thermometer No. 81*, in Verkhoyansk in 1892; as we do not know the true corrections for the thermometer No. 81* in the interval −30° to −70°, it would be more appropriate to use its direct readings without any additional correction. *The lowest temperature of air in Verkhoyansk ought therefore to be considered as* **−68° C [−90.4° F.]**, *it is also the lowest temperature which has ever been observed on the stations of our meteorological net.*

As for the value −72°, which Prof. Voeĭkov gives in his work, it is most probably due to a misunderstanding; it seems, that he added the correction −2.0° once more to the already-corrected reading of the alcohol thermometers, published in the Annals of the Observatory for the year 1892.

Yours truly,

[Signed] B. GALITZIN.

NOTES ON THE HOT WAVE IN SOUTHERN CALIFORNIA, JUNE 14–17, 1917.

By FORD ASHMAN CARPENTER, Meteorologist.

[Dated: Weather Bureau, Los Angeles, July 12, 1917.]

Record June temperatures were experienced generally in southern California during the four days ending June 17, 1917. As this heat wave was unique in the meteorological history of this section of the United States, both in its distribution and effects, some notes have been collected on the subject and are here presented for future reference and study.

Contributing causes of hot waves in southern California—Mr. G. H. Willson gives the following explanation of hot waves in California.[1]

In the late spring, summer, and early fall, when HIGHS cover the North Pacific States and Plateau region, light to moderate, north to east winds prevail over California, and the cool ocean influences are checked or held back. The sky is clear and insolation is great, and the air is heated dynamically in moving down the mountain slopes, causing very high temperatures in the valleys and coast sections. When these conditions are very marked they produce hot waves.

[1] Weather Forecasting in the United States, Washington 1916. p. 338. (W. B. No. 583.)

And the present writer, in discussing a hot wave which occurred at Los Angeles on September 17, 1913, gave the following explanation: [2]

The cause of this hot spell, like all instances of temperatures above 90° in this portion of southern California, was a well-defined "norther" condition brought about by pressure distribution typical of such phenomena.

On September 15 the barometric pressure was high over the Northwest and low in the Southwest. While the low area remained stationary for many days, the high area progressed in a southeasterly direction. The greatest difference in pressure was coincident with the warmest day, when the weather map showed a gradient of a tenth of an inch in barometric pressure to the hundred miles on an east-and-west line.

General weather conditions accompanying the hot wave.—The hot wave of June, 1917, extended over a period of four days; the first indication that a period of warm weather was imminent occurred with the weather map of the 11th, which showed the arrangement of high and low areas typical to such conditions. Up to this date the season had been backward, the weather being cool and cloudy. The ensuing week brought a rapid balancing of the temperature deficiency which was of long standing. At Los Angeles the temperature reached 100° twice in the four days June 14–17, with the maximum of 105° on the 17th. (See fig. 1.) The highest temperature of which we have data, 124° F., was registered at Mecca, Riverside County, on the 15th, and the lowest maximum, 87°, occurred at San Diego. Except along the immediate coast section the mean maximum temperature for southern California for the four days approximated 100°.

Southern California is specially fortunate in having a number of stations equipped with thermographs. In perusing the thermograms from 16 stations it is found that they fall into two general classes: one (illustrated by fig. 2) where the crest of the hot wave was reached on the fourth day; and the other (see fig. 3) where the temperature suddenly touched the highest point on the first day and thereafter steadily diminished. Among stations falling in the first class belong Los Angeles, Pasadena, Mount Wilson, Redlands, Riverside, Corona, Upland, Pomona, San Bernardino, and Santa Barbara. The second class includes San Diego, Escondido, El Cajon, Bonita, Tustin, and Whittier.

Incidental phenomena were associated with the hot wave. The influence of the hot wind at midnight of the 16–17th (see fig. 4), which traversed the seaward side of the mountain range and caused the temperature to rise 15 degrees, is shown at El Cajon, San Bernardino, and Redlands. This hot wind was also felt at many of the desert stations farther south. Another accompanying phenomenon was the effect of the neighboring forest fires on the otherwise equable littoral weather of Santa Barbara (see fig. 5). Special meteorological observer G. W. Russell at that station is probably correct in attributing the abnormal temperatures there to the forest fire. Concerning this phase of the hot wave Mr. Russell says:

[2] The September hot wave in Los Angeles, Cal. MONTHLY WEATHER REVIEW, Washington, Sept., 1913, 41:1404.

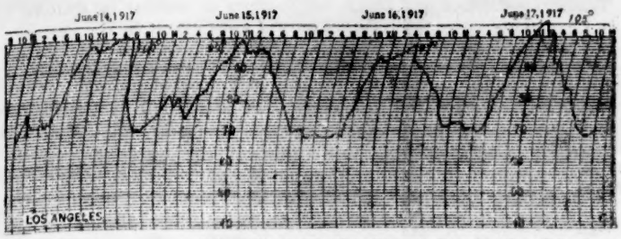

FIG. 1.—Thermogram recorded at U. S. Weather Bureau, Los Angeles, Cal., June 14–17, 1917.

Similar records at Mount Wilson, Pasadena, and other stations within 25 miles of the shore show the same general characteristics.

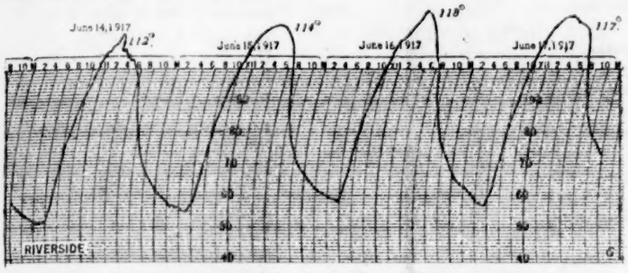

FIG. 2.—Thermogram recorded at Riverside, Cal., June 14–17, 1917.

Similar records at Corona, Upland, Pomona, and the greater portion of the citrus district show the same general characteristics.

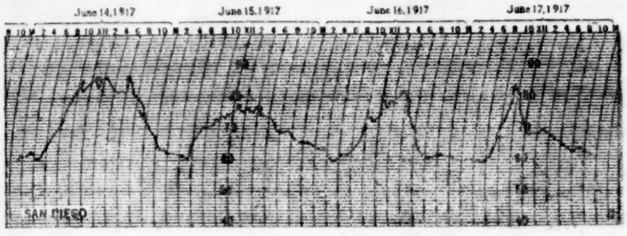

FIG. 3.—Thermogram recorded at U. S. Weather Bureau, San Diego, Cal., June 14–17, 1917.

This curve, with its maximum temperatures on the 14th instead of the 17th, as elsewhere in southern California, is also characteristic of Escondido, Tustin, Whittier, and Bonita, although these stations registered much higher temperatures than these at San Diego.

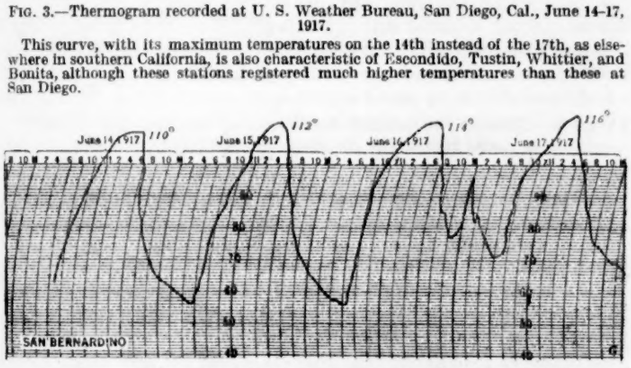

FIG. 4.—Thermogram recorded at San Bernardino, Cal., June 14–17, 1917.

Note the effect of the northeasterly wind about midnight of the 16th–17th. Similar effects were recorded at the same hour at Redlands and at El Cajon, San Diego County; El Cajon, is about 90 miles south of San Bernardino and a little over 10 miles northeast of San Diego.

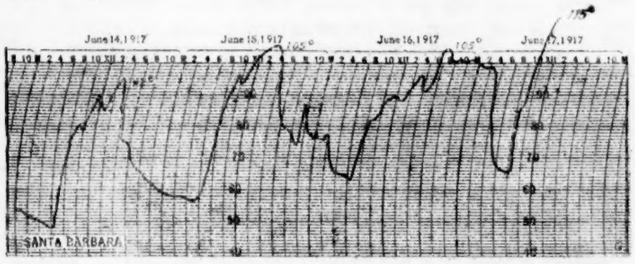

FIG. 5.—Thermogram recorded at Santa Barbara, Cal., June 14–17, 1917.

Note the disarrangement of the daily temperature march, due to forest fires burning within a few miles of the station. Once before, in the past 50 years, has Santa Barbara had such high temperatures, also in connection with forest fires.

If my memory is to be credited, this is the second very hot spell during my life here (Santa Barbara, Oct. 15, 1867, to June 22, 1917); the first spell was about the same time as the Chicago fire (Oct. 9, 1871), when this valley was burned over and considerable damage was done to growing fruit, etc. [On that occasion] apples were cooked on the fire side of the trees, beans and other vegetables were so severely burned that they did not grow again. Birds were often noticed to fly into dwellings to get relief from the heat. One saloon keeper said a little bird flew into a pitcher of water on his bar and nearly drowned in its effort to get water. As there were no instruments in use here there was no means of accurately stating the temperature. I do not remember that any strong wind accompanied that hot spell. Two permanent streams, never before dry, were entirely dry during the two days' heat, but started running again soon after.

This last hot spell was greatly augmented by very strong northeast wind blowing over the forest fire directly toward this city. Many gusts, I estimate, reached a velocity of at least 40 to 45 miles per hour. Of course the anemometer was not capable of recording such a velocity.[3] As to the temperature of the day unaffected by the fire heat, would say that very near this city the temperature near the beach and where the winds from the fire did not affect the temperature, was not unusually high, say about 80° to 85°. The ocean water temperature was not appreciably raised beyond that of ordinary summer days. Swimmers said that it seemed even colder than usual, so they plunged in very carefully.

There have been very many hot spells here during my 50 years' residence, and four years ago the record showed a temperature of 108°, which I think is the highest ever recorded, up to that time.

Saturday, June 16, 1917, forest fires were burning at many points around us here, and the direction of the wind was such as to bring the heat directly across this depression. For some unexplained cause the growing crops, unless walnuts, were not materially affected, and it is believed the beans will entirely recover with the fogs and be very little if any worse for the heat.

Effect of the hot wave on vegetation.

Press comments on the hot wave.—The California Cultivator of June 30 said:

* * * Some lemons of nearly picking size were actually cooked and the tissue immediately broken down. Others had when cut much the same appearance as frosted lemons. Valencias were softened so that picking ceased for several days. They are now returning to normal condition and shipping is resumed. Walnuts suffered greatly, a large number most exposed to the afternoon heat being burned so that they dropped from the trees. The more protected nuts, however, are yet apparently all right. * * *

But with the loss there are some compensations. For instance, one very large orchard company reports that the heat has wiped out practically all black scale from its trees.

The lemon injury is far less serious than would appear at first thought. Nine-tenths of the lemon crop for the season has been harvested. Of that remaining on the tree, the later fall picking, which usually commands good prices, will yet be marketed. It was feared at first that these under half-sized lemons would drop from the tree, but the drop has proved much less serious than at first anticipated, and, unlike the full-grown lemon, the young fruit seems to show less breaking down of the tissue and less injury.

Navel oranges in orchards on very light, sandy soils, and which possibly were suffering for moisture, have shown very severe dropping. Others, especially where well irrigated shortly before the heat, are yet carrying the greater proportion of their crop. Young fruit of Valencias, that is, the crop for next year, shows much less effect of heat than does the navel.

As to the walnut crop, very thorough canvass of the situation has been made by the California Walnut Growers' Association, and the following notice is being sent to the trade:

"Southern California has experienced the hottest spell of weather reported for forty-odd years. During the period from June 14 to 17, inclusive, temperatures ranged from 111° to 123° in the shade in the principal walnut-producing districts. This freakish spell caught the walnuts at a very tender stage before the shells had hardened, and simply cooked a large percentage of them. We have just completed a very thorough investigation of the damage with the following results: Santa Barbara County 5 per cent damage, Ventura County 20, Los Angeles County 25, Orange County 35.

"As the largest productions are in Orange and Los Angeles Counties, the average damage for the entire crop is close to 25 per cent, but as we had a prospect for the greatest production on record, we will still apparently ship about as many walnuts as were marketed last year. * * * We feel confident that our prediction of the damage will prove sufficiently high and that it is as accurate as it is possible to obtain."

[3] Character of instrument not known to the Editor, and not recorded in the Climatological Division, Weather Bureau.

Strawberries and other small fruits suffered from injury to ripening fruit, but young fruit is now coming on and the market is abundantly supplied. Potatoes and beans lacking in moisture at the root suffered, but the great bulk of the crop is in fine condition.

Summarizing the effect of the hot wave on farm products it is generally conceded that the most serious loss will be the navel orange crop, which in some sections is almost a complete loss. Other varieties of oranges were not seriously damaged. Lemons were injured in instances where a considerable amount of mature fruit was on the trees. Much of such fruit was burned while hanging on the trees. Fortunately the greater part of the lemon crop had been picked prior to the period of great heat, so the damage loss is confined to autumn lemons. In this connection it may be remarked that lemon trees are continually in blossom, bud, and fruit. The citrus trees, as such, were not injured. Walnuts had a splendid setting prior to the heat wave, and, while the loss has been considerable, it is believed that the net gains this season will exceed those of last year. Garden truck withstood the heat very well; only early tomatoes were seared; in one district a crop of tomatoes valued at $50,000 became a total loss. Had the heat wave been preceded by several weeks of normally warm weather, vegetation would have accustomed itself to the steadily increasing temperature, but the suddenness of the mounting temperatures and the steadiness of the drying winds followed too closely upon months of cool, moist weather.

Observations at Mecca date garden.—At the United States cooperative date garden at Mecca, Mr. Bruce Drummond, the official in charge, states that following the high temperature of 124°F. on June 15, 1917, a wind averaging 12 miles per hour began at noon and continued for five hours. The relative humidity during the period between 12 noon and 5 p. m. averaged 6 per cent as determined by a sling psychrometer. He states that this wind was desiccating in the extreme, burning up both vine and root in the vineyards; but it did no harm to the dates. One unirrigated date palm decreased 6 millimeters during the drying wind but within 24 hours regained its former diameter. Drummond also states that observations showed that the wind frequently seemed to come in vertical gusts and that the vineyard was burned in spots. An interesting feature during this hot spell (which exceeded all others in severity during the 12 years that the date farm has been in existence) was that the electric fan did not seem to alleviate the distressing physical effect of the heat.

Comparison with previous hot waves in southern California.

Table 2 gives a comprehensive idea as to the frequency and distribution of heated terms in this district. Although the records are from one station only (Los Angeles), they may be taken as indicative of general prevailing conditions south of the Tehachapi Range and a little distant from the coast. Leaving out a consideration of physical discomfort, it is only when the hot spells occur during the late spring or at the beginning of summer months that damage to farm products occurs. There is no doubt but that the hot wave under consideration was the most damaging to fruits and nuts ever experienced in southern California. The closest previous approach to the meteorological conditions which attended this phenomenon occurred on June 24–28, 1883, when the daily maximum temperatures at Los Angeles were 95°, 98°, 100°, and 90° F, respectively. Tradition has it that the spring of 1820 also saw damaging hot winds which destroyed grain and pasture.

TABLE 1.—*Highest and lowest temperatures at stations in southern California during the hot wave of June 14–17, 1917.*

Stations.		Dates. 14	15	16	17
		°F.	°F.	°F.	°F.
Bonita	Highest	110	89	93	94
	Lowest	55	54	54	57
Corona	Highest	112	114	115	118
	Lowest	60	65	59	70
Escondido	Highest	108	101	101	105
	Lowest	55	58	55	60
El Cajon	Highest	113	103	106	103
	Lowest	57	59	56	61
Indio	Highest	.....	123	.....	.....
	Lowest	.....	83	.....	.....
Los Angeles	Highest	100	99	97	105
	Lowest	68	69	68	69
Mecca	Highest	.....	124	.....	.....
	Lowest	.....	83	.....	.....
Mount Wilson	Highest	92	94	95	98
	Lowest	69	68	70	70
Needles	Highest	115	118	118	120
	Lowest	64	66	68	70
Pasadena	Highest	106	107	108	113
	Lowest	59	62	60	71
Pomona	Highest	110	112	115	117
	Lowest	52	55	53	61
Redlands	Highest	108	111	113	114
	Lowest	64	66	64	73
Riverside	Highest	112	114	118	117
	Lowest	55	59	57	67
San Bernardino	Highest	110	112	114	116
	Lowest	55	57	58	73
Santa Barbara	Highest	92	105	105	115
	Lowest	48	57	63	65
San Diego	Highest	87	77	82	85
	Lowest	61	62	60	60
Tustin	Highest	107	97	94	96
	Lowest	48	50	52	55
Whittier	Highest	111	105	103	111
	Lowest	54	58	57	60
Upland	Highest	106	109	111	115
	Lowest	62	64	63	71

TABLE 2.—*Monthly and annual distribution of temperatures of 100° F. and over at Los Angeles, Cal., 1877–1917.*

Year.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Number.
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	
1878	.....	.....	.....	.....	.....	103	.....	1
1879	.....	.....	[a] 104	.....	.....	[a] 101	.....	4
1881	.....	.....	.....	.....	100	102	.....	2
1882	.....	.....	.....	.....	.....	100	.....	1
1883	.....	100	100	.....	.....	[b] [f] 104	.....	6
1884	.....	.....	.....	.....	[b] 102	.....	.....	2
1885	.....	.....	.....	.....	[c] [e] 106	108	102	5
1887	.....	.....	100	.....	.....	.....	.....	1
1889	.....	.....	.....	.....	.....	103	.....	1
1890	.....	.....	[c] 105	.....	.....	.....	.....	2
1891	.....	.....	.....	[a] [d] 109	.....	100	.....	4
1895	.....	.....	100	.....	.....	.....	.....	1
1896	.....	103	.....	.....	.....	.....	.....	1
1899	.....	.....	.....	.....	.....	.....	100	1
1905	.....	.....	.....	.....	101	.....	.....	1
1906	.....	.....	.....	.....	.....	105	.....	1
1907	.....	.....	.....	[a] [c] 103	.....	.....	.....	3
1909	.....	.....	.....	.....	101	[c] 103	.....	3
1910	100	.....	.....	.....	.....	.....	.....	1
1912	.....	.....	.....	.....	.....	100	.....	1
1913	.....	.....	.....	.....	.....	108	.....	1
1917	.....	.....	[a] 105	.....	.....	.....	.....	2
Number	1	2	9	6	8	17	2	45

[a] Also 100°. [b] Also 101°. [c] Also 102°. [d] Also 103°. [e] Also 104°. [f] 102° twice.

The extreme highest temperature, 109°, was registered on July 25, 1891.

CHANGES IN WEATHER BUREAU PROGRAM OF METEOROLOGICAL OBSERVATIONS.[1]

The present program of meteorological observations by the Weather Bureau was put into effect forty-odd years ago; it was organized with special reference to the daily forecasts and warning service and, needless to say, no material changes therein have been made unless dictated by consideration of the forecast service. For some years past, however, it has been recognized within the bureau, and to a less extent without, that a series of observations and reports which may be eminently satisfactory as a basis for weather forecasts and warnings may not be well adapted to the study of many problems in which the weather plays an important part.

For this and other reasons a committee (Prof. A. J. Henry, chairman) of Central Office officials was appointed on November 1, 1916, to consider the observational work of the bureau and report what, if any, revision or extension is practicable.

The committee has submitted its report and the latter has been approved, effective January 1, 1918.

It seems desirable that a brief preliminary statement be made at this time with reference to the changes that are in contemplation.

For several reasons, chief of which is the press of other important work, the ideal observational program can not be adopted, but the committee has recommended a few minor additions to the present program which it is believed will not greatly augment the present volume of work at stations. These additions are as follows:

(1) The making of an observation of relative humidity and cloudiness at all principal stations at the uniform hour of noon, local mean time;

(2) The compilation of wind direction and velocity from the automatic record sheets at selected stations;

(3) The collection of statistics of hail, thunderstorms, and tornadoes in greater detail than at present.

While the present program permits the taking of a midday observation of humidity, the time of taking it is optional with the official in charge. The change recommended and approved requires an observation at the uniform hour of noon, local mean time, to which is added a deliberate observation of the clouds, their direction and approximate speed, made with all the skill that is at the command of the observer.

There is perhaps greater need of improvement in current methods of cloud observation than in the observation of any other single element. This arises not alone from the fact that such data is of value in the study of dynamic meteorology; but especially because aerial navigation has now become a so important practical matter. The classification or naming of the clouds by observers in accordance with the standard nomenclature is particularly in need of improvement and the ability to distinguish between upper and lower clouds should also be studiously cultivated. The plan contemplates the use of a nephoscope in determining cloud motions at the noon hour, and eventually that apparatus will be used in all cloud observations whenever conditions permit.

In compiling data of wind direction and velocity from each of the eight principal points of the compass, as was formerly done, the object is to secure more detailed information as to the movement of the surface winds than is made available by the present system.

The details of the thunderstorm campaign will be announced later. The general plan contemplates the enlistment of a large number of thunderstorm observers throughout a zone, say, 200 miles wide, extending from Iowa to New England, thus forming part of a transcontinental air route. It will doubtless be necessary to extend the network of thunderstorm observations over other zones.

The taking of phenological observations was favored by some, but since that subject is, and has been, in conference in the Interbureau Committee of the Department, no action was taken by the program committee.

[1] Condensed from the fuller preliminary report by Prof. A. J. Henry in "Weather Bureau Topics and Personnel," Washington, August, 1917.—EDITOR.

THE WEATHER BUREAU AND THE WAR.[1]

The use of aeroplanes, dirigible and captive balloons, highly perfected and powerful artillery, noxious gases, and other modern methods of warfare in Europe to-day [1914–1917] have emphasized the importance of foreknowledge of existing weather conditions both on the earth's surface and to some considerable distance aloft. Recognizing the value of such knowledge to those planning military operations, and following the example set by all the other belligerents of to-day, the Secretaries of Agriculture and of War have arranged for full cooperation between the United States Weather Bureau and the Army.

The military activities of the Weather Bureau for the time being resolve themselves into two primary projects: (1) Forecasting the weather for purely military operations; (2) the sounding of the upper air for the benefit of aviators, balloonists, and artillerists.

In connection with the first project, District Forecaster E. H. Bowie, of the Washington office, has been commissioned a major in the Signal Officers' Reserve Corps and has been granted a furlough from the Weather Bureau on that account. It is understood that Maj. Bowie will be assigned to the staff of General Pershing, as principal forecaster. In the furtherance of his duties it is expected that the closest cooperation will exist with the French and English meteorological services in the use of data and reports obtained by them, supplemented by additional observations in the field and cable reports from the United States and its possessions. It is likely that Maj. Bowie will remain in Europe during the period of the war.

Dr. William R. Blair, meteorologist, who has been in charge of the aerological investigations of the bureau, has also been commissioned a major in the Signal Officers' Reserve Corps and placed in charge of the military aerological work. The aerological work heretofore performed by the Weather Bureau will be continued, in addition to the enlarged activities made possible by the appropriation of $100,000 for this work, as contained in the Army bill which became a law May 12, 1917. This item reads as follows:

> For the establishment and maintenance by the Weather Bureau of additional aerological stations, for observing, measuring, and investigating atmospheric phenomena in the aid of aeronautics, including salaries, travel, and other expenses in the city of Washington and elsewhere, $100,000, to be expended under the direction of the Secretary of Agriculture.

The work to be conducted by Maj. Blair in the Signal Corps will include the taking of observations of the upper air, for the immediate benefit of aviators, artillerists, etc. This work will be continued, not only at the front, but at military camps in the United States. It is planned that, for the duration of the war, the aerological work of the Weather Bureau and the Signal Corps shall be closely

[1] Condensed from an article by Edgar B. Calvert in "Weather Bureau Topics and Personnel," Washington, August, 1917.—EDITOR.

coordinated, and that such of the free-air observations made at the six primary stations to be operated by the Weather Bureau, as may be required, shall be made telegraphically available to the military authorities, supplementing similar observations made at the various military stations conducted independently by the Signal Corps. All the data secured at the Weather Bureau and the military stations will be turned over to the Weather Bureau for tabulation and study.

Five aerological stations, in addition to the one already maintained at Drexel, Nebr., are being established as rapidly as possible. One of these stations will be located at Ellendale, N. Dak., and the work in connection therewith has progressed to such an extent that it is expected that it will be in full operation before October 1, 1917. The sites for the other stations have been tentatively selected and the announcement of the exact location will be made later.

NORMAL ANOMALIES OF MEAN ANNUAL TEMPERATURE VARIATIONS.[1]

By H. ARCTOWSKI.

[*Reprinted from* Science Abstracts, Sect. A, July 30, 1917, §591.]

When mean daily temperatures are plotted to form an annual curve certain discontinuities are often observed. Attention has frequently been called to a sudden fall of temperature which often occurs in the spring, particularly in May or June, but it has not been so generally recognized that similar rises of temperature occur in autumn. These discontinuities suggest that the mean annual curve is formed of portions of several smooth curves, the transition from one to the next being brought about by a sudden change as shown in the figure [omitted]. These component curves have not necessarily all the same amplitudes, though in some cases they will be similar and the one simply be displaced up or down from the other. It is suggested that these changes from one curve to another may sometimes be due to a sudden change in the amount of atmospheric moisture above the station with a consequent alteration in the strength of the solar radiation received. There is evidence that the steps occur at approximately the same date at such widely separated stations as Baltimore, Md., in North America, and Barnaoul, in Siberia.—*J. S. Di[nes]*.

STRUCTURE OF HAILSTONES OF EXCEPTIONAL FORM AND SIZE.[2]

By F. E. LLOYD.

[*Reprinted from* Science Abstracts, Sect. A, July 30, 1917, §594.]

A violent hailstorm of short duration at Carmel, Cal., [—, 1916], yielded large hailstones of unusual shape. Around a central core radiating arms projected having the form of icicles. It is suggested that the stones in the course of their formation were rotating, and thus the arms were built up by the throwing out of the water centrifugally. The suggestion is offered that when hailstones of exceptional type fall molds might be made by pressing plasticine around them before the ice has time to melt, and thus a permanent record of their shape would be obtained.—*J. S. Di[nes]*.

[1] Amer. jour. sci., May, 1917, 43:402–409; Phil. mag., June, 1917, 33:487–495.
[2] Trans., Roy. Soc. Canada, Sept., 1916, 10:47–50.

IMPROVED METHODS IN HYGROMETRY.[1]

By A. N. SHAW.

[*Reprinted from* Science Abstracts, Sect. A, May 26, 1917, §365.]

A hygrometer of a type recently developed by E. K. Rideal and A. Hannah was tested and very satisfactory results obtained. In this instrument a known volume of the sample of air is drawn into the apparatus and the decrease in volume at constant pressure is determined after drying on sulphuric acid. The vapor pressure can be calculated in a few seconds from the reading of the instrument and the barometric pressure at the time. It was found that each observation required only from 2 to 4 minutes and an accuracy within about 1 per cent was obtained, whether the temperature and humidity were high or low.

The principle of a second type of hygrometer tested was based on the fact that certain salts will absorb water from the atmosphere in an amount which is closely proportional to the vapor pressure existing at the time. A clean filter paper moistened with a solution of P_2O_5 was suspended in a bottle from one arm of a balance. A constant stream of air was drawn through the bottle, and it was found that the humidity could be determined satisfactorily from the weight of the paper. The apparatus required to be calibrated by comparison with a standard method, but this once done the paper was found to remain without deterioration for a long time. A convenient form of the instrument can be constructed by hanging the paper from a sensitive spring balance in a tube open at both ends, the air circulation being maintained by a small pilot light in the top of the tube. The spring balance can be graduated to read in vapor pressure directly.—*J. S. Di[nes]*.

FACTORS INFLUENCING THE CONDENSATION OF AQUEOUS VAPOR IN THE ATMOSPHERE.[2]

By A. MASINI.

[*Reprinted from* Science Abstracts, Sect. A, July 30, 1917, § 587.]

Experiments on the condensation of water vapor in the air under different conditions give the following results: The formation of the nuclei which, besides dust, may provoke the condensation of atmospheric aqueous vapor is determined specially by the presence of ozone, nitrogen peroxide, and indirectly ammonia. Electrical discharges, flames (independently of their fumes) and glowing bodies favor condensation in so far as the above substances are formed in their neighborhood. The property exhibited by some substances, of distributing fumes in the air, is identified with the phenomenon of deliquescence, the latter property being manifested without the surrounding medium being saturated with moisture. The conception of a medium saturated with vapor is, at any rate in practice, of relative and not absolute character. This relativity is implied by Kelvin's law, according to which the condensation or dew point depends not only on the vapor pressure but also on the radius of curvature of the surface of bodies in the immediate neighborhood of particles of vapor; it must now be extended to the consideration of the nature of these bodies and of their distance from molecules of the vapor.

Contrary to the conclusions of Lenard and Ramsauer, the action of the ultra-violet light is not necessary for the formation of the nuclei and functions only as a source

[1] Trans., Roy. Soc. Canada, 1916, 10:85–92.
[2] Nuevo Cimento, ———, Sept., 1916, 12: 110–129.

of ozone. Further, gaseous ions exhibit no power to constitute condensation nuclei, so that ionization of the air by either radioactive substances or Röntgen rays has not been shown to be a necessary or sufficient cause for the condensation of supersaturated aqueous vapor.

Trees, especially tall ones and those rich in resins, give rise to ozone, and should therefore favor production of rain. Opinions on the actual influence exerted by trees are, however, very variable.—*T. H. P[ope]*.

EVAPORATION OF MERCURY DROPLETS SUSPENDED IN A GAS.[1]

By A. SCHIDLOF & A. KARPOWICZ.

[*Reprinted from* Science Abstracts, Sect. A, Sept. 28, 1914, § 1569.]

The authors have previously experienced difficulty with experiements as to the value of the electron charge from the motion of mercury droplets between the plates of a condenser, in that the speeds of these drops become less with increase of time under given fields. They have now tried nitrogen as well as air between the condenser plates and extended the time to over an hour. The speed-time graphs slope down in the same way for each gas, the speeds becoming less and less as time goes on. The reductions in an hour's time are to about $\frac{1}{2}$ in the case of air and to about $\frac{1}{5}$ for nitrogen. It is also noticed that the droplets become more difficult to see as the experiments proceed. The conclusion adopted is that the droplets of mercury suffer evaporation under the action of the light.—*E. H. B[arton]*.

EVAPORATION AND ADSORPTION.[2]

By A. SCHIDLOF.

[*Reprinted from* Science Abstracts, Sect. A, July 30, 1917, §578.]

Gives a theory of the phenomena of continuous variation of the mass and of the density of drops of mercury maintained in suspension in a gas.

The hypothesis of molecular bombardment leads to the supposition of a film or layer of adsorption covering the surface of a liquid which is in the presence of a gas. The supposition of this layer of adsorption, combined with that of the molecular bombardment, suffices to explain the whole of the facts observed by A. Targonski.—*E. H. B[arton]*.

DYNAMICS OF REVOLVING FLUIDS.[3]

By LORD RAYLEIGH.

[*Reprinted from* Science Abstracts, Sect. A, Apr. 30, 1917, § 287.]

Meteorology depends ultimately so greatly on the mechanics of revolving fluids that the clear formulation of such simple conclusions as are within reach may be expected to guide the judgment when exact analysis seems impracticable. Aitken's recent paper on "The dynamics of cyclones and anticyclones" is taken as the starting point of the present inquiry, although the present author dissents in some respects from Aitken's views. The condition of symmetry round an axis is here imposed throughout, so that the fundamental equations are most appropriately expressed in terms of cylindrical coordinates, r,θ,z, the velocities u,v,w, being measured in the directions in which these increase. It is then shown that rv may be considered to move with the liquid, in accordance with Kelvin's general theorem respecting "circulation," provided that where V is the potential of extraneous forces, $P \equiv \int dp/\rho - V$, be independent of θ, which will be the case if ρ be constant or a known function of p, and P be single valued. The motion u,w, will then be the same as for $v=0$, provided we introduce a force v^2/r along r.

Case $u=w=0$.—Let gravity act parallel to z (measured downward) on a gas following Boyle's law. Then at a constant level p diminishes inward. But the resulting rarefaction will not cause ascent, inflow of the heavier part outside being prevented by the centrifugal force. The equilibrium of fluid revolving one way round in cylindrical layers between coaxial cylindrical walls will be stable only if the circulation increases with r, and neutral for the circulation constant. With a viscous fluid the stability will be unimpaired by rotation of the outer cylinder, but destroyed by rotation of the inner one. This does not conflict with Kelvin's condition of minimum energy that vorticity must increase outward ("Collected Papers," v. 4, p. 175), for he supposed operations on the boundary changing the moment of momentum, which is here constant. On the other hand, he maintains the strictly two-dimensional character of the admissible variations. But the passage from one two-dimensional state to another may be effected by variations which are not two-dimensional. Of course transition from unstable to permanent stable equilibrium is impossible without dissipative forces, as in the case of a heterogeneous liquid under gravity. But ordinary viscosity does not meet the requirements here considered, as it would interfere with the constancy of circulation. For purely theoretical purposes, however, there is no inconsistency in supposing the u,w, motion resisted while the v motion is unresisted.

Case $u=f(r,t)$, $w=0$ or finite constant.—Then P is independent of z, and the pressure is determined by the equation,

$$du/dt + udu/dr = -v^2/r - \mathrm{P}d\mathrm{P}/dr.$$

For an incompressible liquid r is determined by the equation of continuity $ur = \phi(t)$, and when u and the initial conditions are known, v follows. The motion, now two-dimensional, is conveniently expressed in terms of the vorticity, which moves with the fluid, and the stream function. For the former initially, and therefore permanently, constant throughout the fluid, the appropriate solution shows that if centrally the motion be one of pure rotation, as of a solid, the outer wall will close in, and, in addition to the pure rotation, the fluid will acquire the motion of a simple vortex of intensity, increasing as the radius of the outer wall diminishes. If the fluid be contained between two coaxial cylinders, both walls must move inward together, and the process will end when the inner wall reaches the axis; but the inner wall, or both, may be dispensed with, and the inflow at $r=r_1$ be supposed removed. It will then remain true that, if it thus pass at a constant pressure, the pressure at $r=r_2$ must continually increase. If a limiting pressure be reached, the inward flow must cease. Calculation of any more general case does not seem practicable, but it can be seen that when the u,w motion is slow relatively to the v motion a kind of equilibrium theory is approximately applicable, much as when the slow motion under gravity of a

[1] Comptes Rendus, Paris, June 29, 1914, 158: 1992-1994.
[2] Archives des Sciences, ———, Mar., 1917, 43:217-244.
[3] Proceedings, Roy. Soc., London, Mar. 1, 1917, 93:148-154.

variably dense liquid retains approximately its horizontal stratification; e. g., oil standing over water can be siphoned off without much disturbing the water. When the density varies continuously, the siphon would tend to draw from the horizontal stratum at which it opens; or if the liquid escapes slowly through an aperture in the bottom of the containing vessel only the lower strata are disturbed. So when the revolving fluid is drawn off near a point on the rotation axis the surfaces of constant circulation tend to remain cylindrical, and the more decidedly the faster the rotation. The escaping liquid is drawn always from along the axis, and not symmetrically in all directions, as when there is no rotation. The stability of fluid motion in cylindrical strata requires only an increase outward in the square of the circulation; but if the latter be in both directions this involves discontinuities and for stability rigid symmetry with respect to the axis. Without this limitation the motion will be unstable, so that stability really requires circulation in one direction only. The general question of two-dimensional motion of liquids between fixed coaxial cylindrical walls has been treated by the author in a former paper ("Scientific Papers," v. 1, p. 487), and it may be shown, as on the lines of the demonstration there given for plane strata, that the motion in cylindrical strata is stable provided that the rotation either continually increases or continually decreases in passing outward from the axis.—*G. W. de T[unzelmann]*.

Henry B. Scudder, 1844–1917.

By G. N. SALISBURY, Meteorologist and Section Director.

[Weather Bureau Office, Seattle, Wash., Sept. 12, 1917.]

Mr. Henry B. Scudder, cooperative observer of the Weather Bureau at Moxee near North Yakima, Wash., died at his home in Moxee on July 20, 1917. The Moxee cooperative station was under his direction from March 11, 1892, until the date of his death. His record was without interruption for a period of 25 years 4 months, making it the longest individual cooperative record kept in the State of Washington.

He was born in Brookline, Mass., June 18, 1844. He was a student at Williams College, when, at the outbreak of the Civil War, he enlisted as a private in the Forty-fifth Massachusetts Regiment. He moved to North Yakima, Wash., in 1888, and settled with his family on his Moxee ranch. He was actively interested in the development of the Yakima Valley, assisting in the organization of several of the first large irrigation enterprises, and helped toward bringing about Government reclamation work in the valley. He brought from the East the first registered Holstein cattle in the valley. For many years he was one of the heaviest hop growers in the valley, and spent much time and interest to better that branch of farming. He built the first silo in his part of the State. For 27 years he was a director of the First National Bank of North Yakima, and was the oldest real estate and insurance operator in the city, maintaining his business uninterruptedly for about 28 years.

A long record with the same exposure, and so far as possible with the same instruments and by the same observer, is the prime fundamental requisite for reliable knowledge of the climate of any section of the globe lying outside the Tropics. Those who secure to us such records deserve to be enrolled on the list of honor in climatology and science, and it is a pleasure to us all to record the above tribute to Mr. Scudder. Our satisfaction is heightened by a communication which states that Miss Alice B. Scudder, daughter of the deceased, has volunteered to continue the excellent record already secured. We may thus justly expect to secure, eventually, another specially long and notably homogeneous record whose observers will be listed with the other honorable names found in the list "Distinguished Cooperative Observers" (MONTHLY WEATHER REVIEW, June, 1907, **35**: 277–278).—C. A. jr.

SECTION III.—FORECASTS.

FORECASTS AND WARNINGS FOR AUGUST, 1917.

By ALFRED J. HENRY, Supervising Forecaster.

[Dated: Washington, Sept. 16, 1917.]

August of 1917 opened with unseasonably high temperatures in northeastern districts and these high temperatures continued until the afternoon of the 20th, when a perceptible cooling was brought about by the occurrence of rather general showers over New England and the Middle Atlantic States. The cooling induced by the showers was further augmented by the eastward drift of high No. *I*, Chart II.

The paths of 10 principal and 4 secondary LOWS have been charted (see Chart III). The majority of these LOWS originated in Alberta and moved eastward as shown. None of them presented characteristics worthy of mention, with the exception of the secondary depression marked *IIIA*. This low apparently had its origin in the southern end of primary LOW *III*, which on the evening of the 9th extended from the mouth of the St. Lawrence southward to the Carolinas with pressures in Virginia and eastern North Carolina of 29.82 to 29.84 inches.[1] There was at that time, however, no indication of an independent cyclonic circulation in the southern end of the trough-shaped primary LOW. On the following morning Nantucket Shoals Lightship reported a barometer reading of 29.34 inches and a wind of 64 miles an hour from the northeast. The near-by station of Nantucket, on the island of that name, reported a barometer reading of 29.62 inches and a northeast wind of 22 miles per hour. The report from Block Island, immediately to the westward, gave a barometer reading of 29.70 inches and a north wind of 22 miles an hour.

Four fishing vessels in the path of the storm after it left Nantucket were lost, and the total number of fishermen who perished is believed to be 41. After leaving the place where the fishing vessels were lost—about 50 miles south-southeast of Highland Light, Mass.—no further observation of the storm has come to hand. Evidently it dissipated before reaching the Grand Banks. It has been suggested that the storm was of tropical origin and that it escaped notice by reason of its very small diameter. An examination of the Nantucket barogram shows that pressure fell steadily from noon of August 8 until about 4 a. m. of the 10th, when there was a marked increase in the rate of fall which continued until about 10 a. m. on that date, the total fall in the four hours being 0.25 inch. The pressure then rose as rapidly as it had fallen and in about 10 hours had reached the level it had at the time the sharp fall began. The Nantucket curve is unlike that characteristic of a tropical cyclone, but it should be remembered that the station was not in the center of the cyclone. A similar case of a sharp fall in the barometer in connection with a cyclonic center over the continent is recalled. On October 21, 1904, the barometer at Atlantic City, N. J., fell sharply 0.6 inch and quickly rose to its former level, the complete oscillation occupying about 20 hours. Nothing further was heard of this remarkable depression.

Less than half of the LOWS figured on Chart III, as originating west of the Mississippi, reached the Atlantic and about the same percentage of the HIGHS (see Chart II) of origin west of the Mississippi likewise failed to reach the Atlantic.

The only storm warnings of the month were issued in connection with the storm charted as *No. III A.*, above described.

WARNINGS FROM OTHER DISTRICTS.

Chicago district.—No frost warnings were issued during August, 1917, except for extreme northwestern Wyoming on the 4th, and for the cranberry marshes of Wisconsin on the 9th, 27th, 28th, and 29th.—*H. J. Cox, district forecaster.*

New Orleans district.—Precipitation occurred with unusual frequency for the season of the year over the northern portion of the district and the greater part of it was covered in the forecasts. No storm warnings were issued and no storms occurred.—*I. M. Cline, district forecaster.*

Denver district.—The usual summer type of weather prevailed. No general storm developed in or passed over the district during the month, and a deficiency in precipitation was noted in localities. Decided departures from seasonable temperatures occurred mostly in connection with afternoon thunderstorms. No special warnings were issued, except for moderately high winds in localities in Colorado on one or two dates.—*F. H. Brandenburg, district forecaster.*

San Francisco district.—The weather conditions prevailing in this district during August, 1917, were normal. An area of high pressure prevailed in the North Pacific during the entire month while a trough of low pressure continued over California, and occasionally extending northward over the interior of Oregon and Washington. On the 7th, a portion of the northern HIGH moved eastward through British Columbia and the northern Rocky Mountains region; but on other occasions when there was a tendency toward a movement inland, it was followed within 24 hours by a recession into the Pacific.

The depression over the interior of California was exceptionally sluggish throughout the month showing no tendency toward moving eastward, and not sufficient energy to develop a rain condition except on the 24th and 25th, when light showers occurred in the mountains in the extreme south.

Fire-weather warnings were issued in Washington, Oregon, and Idaho on August 8 and 31, and fairly well verified. Many forest fires prevailed in the northern section during the month, but the losses were not large. The fires are reported to have been incendiary.

No storm warning was issued and none was experienced.—*E. A. Beals.*

[1] Note added Oct. 10, 1917: Information recently received indicates that this cyclone had its origin east of the Virgin Islands, passed thence west-northwestward and eventually recurved to the northeast.—*A. J. Henry.*

A QUINTETTE OF COLD WAVES IN FLORIDA.

By ALEXANDER J. MITCHELL, Meteorologist.

[Weather Bureau office, Jacksonville, Fla., May 25, 1917.]

(Accompanied by Charts XLV-85 and XLV-86.)

Introductory.

Cold waves are closely associated with the development and movement of areas of high pressure (anticyclones) and areas of low pressure (cyclones). The movement of the cold wave in latitude is largely controlled by the movement of the cyclone immediately preceding. If the latter has moved over a track that extended far to the southward, the cold wave will usually pursue a similar path. In its mechanical development the cold wave is the antithesis of the low-area storm, the former having downward components, whereas the latter has ascending components.

The late Prof. Cleveland Abbe, writing of cold waves several decades ago, said[1] "The cold waves of the whole Northern Hemisphere, as studied on the daily weather charts, evidently have most to do with the great areas of low pressure on the Atlantic and Pacific Oceans, and the great areas of high pressure over Asia and America." And the later investigations of the origin and development of areas of high pressure (anticyclones) by Bigelow and others have amplified the subject to a gratifying extent. Prof. Garriott's atlas of cold-wave maps (Weather Bureau Bulletin **P**, 1906) is a very convenient guide to the accompanying weather conditions, which are there amply illustrated.

Florida has to do no less with frosts and cold waves than with the hurricanes of the Tropics. In fact, aside from loss of life on land incidental to tropical hurricanes, statistics during recent years show that the losses due damage to fruit and truck crops, the loss of stock from exposure, the discomfort and suffering of the poor, and the more or less widespread embargo on transportation as a result of heavy snowfall in northern districts, resulting from cold waves, bring them up to the rank of the hurricane in their capacity for destroying property and demoralizing human industry. It is established, however, that cold waves are of shallow depth; that a transverse barrier, say 8,000 or 10,000 feet high, extending from the South Atlantic to the Plains States, would materially affect their southward sweep. Were such an artificial barrier feasible the agricultural and horticultural interests of the South would be subjected, in great measure, only to such climatic vicissitudes as might arise from latitude together with the modifying effects of the Atlantic Ocean and the Gulf of Mexico.

Severe cold waves in Florida.

The effects of the cold wave of February 3 and 4, 1917, resulting in severe losses among citrus fruits and other vegetables in Florida and the adjacent territory, make an interesting comparison with similar conditions during previous cold-wave years.[2] The severest cold waves of authentic record in the South since the Federal weather warning service was established were those of January, 1886; December, 1894; and Februaries in 1895, 1899, and 1917, thus making 5 within a period of 31 years. There is also the known cold wave of February, 1835; and although the temperature on that occasion is alleged to have approximated 10°F. over extreme northern Florida, the absence of well-authenticated or of official reports compels one to some reserve in accepting the available data.

Frost occurs in the Florida Peninsula with slight pressure gradients, although the pressure at the crest of the HIGH to the north and west is usually 30.2 inches or higher. Severe cold waves generally are an accompaniment of areas of high pressure of great magnitude, preceded by areas of low pressure, which are frequently of great depth. The farther south the track of the area of low pressure is located, the more severe, as a rule, will be the cold wave in lower latitudes. The types of the HIGHS, their maximum central pressures, and the associated LOWS incident to the progress and development of the cold waves previously mentioned are indicated in the following paragraphs and Table 1.

January, 1886.—The maximum central pressure of this cold wave was 31.0 inches in Alberta on the morning of January 8. Its movement southward was preceded by the development of a LOW in southeastern Texas on the 7th, which moved northeastward over the Gulf States on subsequent dates.

December, 1894.—The maximum central pressure of this cold wave was 31.3 inches in Alberta on the evening of December 26. It was preceded by a LOW in eastern Texas concerning which the MONTHLY WEATHER REVIEW (December, 1894, **22**:489, No. *XIV*) remarked: "The great development of this storm on the 27th contributed somewhat to the southward flow of cold air which culminated in Florida on the 29th."

February, 1895.—The maximum central pressure of this cold wave was 31.4 inches in Alberta on the morning of February 6. This phenomenal HIGH was preceded by a LOW near the Texas coast, which moved northeastward over the Gulf States during the 5th and 6th.

February, 1899.—This cold wave had a maximum central pressure of 31.4 inches in Alberta on the morning of the 11th. It was preceded by a LOW which was first noticed when over New Mexico—probably one of the "South Pacific" type—and it moved northeastward near the coast line, crossing the Florida peninsula between Jacksonville and Tampa. The cold wave was attended by snow over northern and central Florida during the night of February 12.

February, 1917.—The maximum central pressure of this cold wave was but slightly lower than the three preceding ones. The highest barometer was 31.1 inches in Alberta on the morning of February 1. It was preceded by a LOW of the North Pacific type which moved to the Central Valleys during January 30–31, and thence to the North Atlantic. This was the only North Pacific LOW that was associated with any of the five Florida cold waves here under consideration.

The location of the area of highest pressure 24 hours before the cold wave reached Jacksonville, Fla., and the depth of the preceding LOW are so related as to be of interest in the study of the rapidly shifting areas. The marked rapidity of movement of the HIGH on February 2–3, 1917, was somewhat unusual, although the configuration of the isobars showed that it would move with great celerity.

[1] *Cf.* also his remarks in his "Preparatory Studies," etc., pp. 154–155 (Ann. Rpt., C. S. O., 1889. App. 15).—C. A., jr.

[2] For lists and accounts of Florida freezes prior to September, 1895, see "Florida Freezes for a Century and a Half," by Geo. R. Fairbanks, in this REVIEW, September, 1895, 23:336–337; also a brief paragraph in the REVIEW, August 1898, 26:360.—EDITOR.

TABLE 1.—*Synoptic view of elements and effects of the five severe cold waves in Florida.*

Dates of occurrence of cold waves at Jacksonville, Fla.	Highest pressure and location 24 hours previous.	Lowest pressure at Jacksonville during passage of preceding LOW.	Range in pressure.	Lowest temperature at Jacksonville.	Effects of cold wave.
	Inches.	*Inches.*	*Inches.*	°*F.*	
Jan. 12, 1886.	Dakota, 30.8	29.5 on 8th	1.3	15	Vegetables killed; citrus fruits frozen in north and central portions. Many fish frozen in shallow waters.
Dec. 28, 1894.	Texas, 31.0	29.8 on 26th	1.2	14	Vegetables and pineapples killed; citrus fruits frozen in north and central portions. Trees defoliated.
Feb. 8, 1895.	Dakota, 31.1	29.6 on 7th	1.5	14	Citrus trees killed north and central and damaged some sections south portion.
Feb. 13, 1899.	Texas, 31.0	29.6 on 7th	1.4	10	Severest cold wave of record in Florida. Destroyed most of citrus trees except in extreme south. Heaviest snow fall of record, trace of snow occurring in south-central portion of State.
Feb. 3, 1917.	South Dakota, 30.9.	29.8 on 1st	1.1	16	Trees defoliated and fruit frozen on trees in north and central portions; some damage in south portion of State. All truck killed.

It is noted that, including the one of February, 1835, four of the six cold waves occurred during February when the thermal tendency is upward, and only one during January, the coldest month of the year. The cold wave of February, 1899, was the only one whose preceding LOW dipped to the Gulf of Mexico and thence across the Florida Peninsula. It was also characterized by Florida's record snowfall and low temperature for, possibly, 60 or 70 years.

Figures 1 to 4 (Charts XLV–85 and 86) are reproductions of the 8 a. m. and 8 p. m. weather maps for February 2–3, 1917. In a general way they are typical of the pressure distribution in the severe cold waves that reach lower latitudes. A study of antecedent conditions show that, although cold waves lose intensity as they push southward, yet the outflow of cold air from the phenomenal HIGHS is so pronounced as to reach even the lower portions of the Florida Peninsula. Figure 5 shows the lowest temperatures ever recorded in Florida.

Hitherto, the limiting southern position of the frost line in Florida has been a geographical enigma. Since January, 1886, which brought some of the severest abnormally cold weather since that of February, 1835, the southern limit of frost in Florida has been a feature of every cold wave, each increase in severity, pushing the known frost line farther equatorward. During 1916 the Chief of Bureau authorized the establishment of a cooperative meteorological station at Long Key, Monroe County, Fla., which is about equally distant (60 miles) from Homestead on the north and Key West on the south. On February 4, 1917, a temperature of

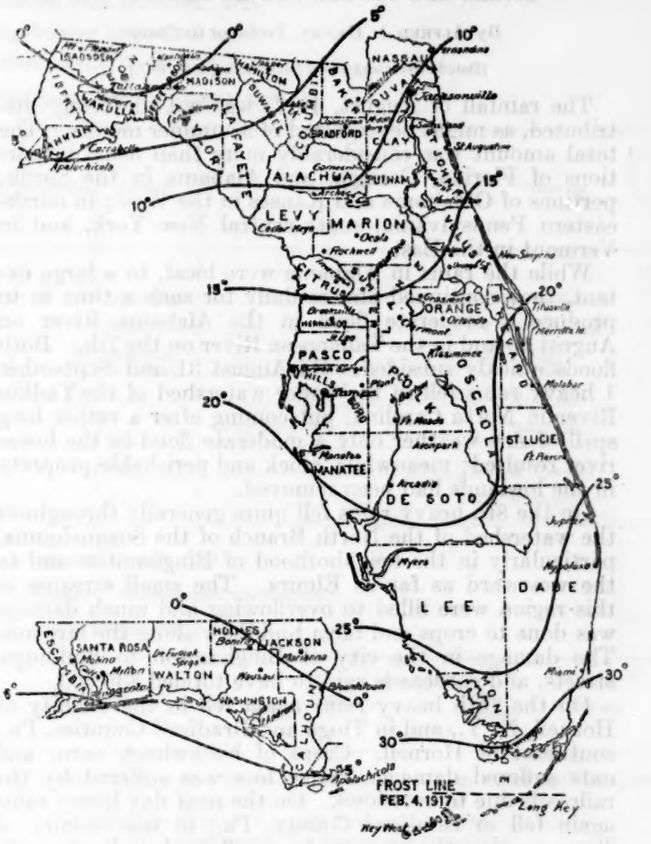

FIG. 5.—Extreme minimum temperatures in Florida, 1870–Feb. 28, 1917.

37°F. was recorded at Long Key. This temperature, of course, indicated frost deposit provided other factors were favorable, which was the case. In all probability, Long Key is the southern limit of frost formation on the islands adjacent to, or on the littoral of the United States.

SECTION IV—RIVERS AND FLOODS.

RIVERS AND FLOODS DURING AUGUST, 1917.

By ALFRED J. HENRY, Professor in Charge.

[Dated: River and Flood Division, Sept. 26, 1917.]

The rainfall of August, 1917, was not uniformly distributed, as might be expected of a summer month. The total amount was considerably more than usual in portions of Florida, Georgia, and Alabama in the South; portions of Oklahoma and Kansas in the West; in northeastern Pennsylvania, south-central New York, and in Vermont in the East.

While the rains in Alabama were local, to a large extent, they continued almost daily for such a time as to produce a moderate flood in the Alabama River on August 10 and in the Tallapoosa River on the 7th. Both floods quickly subsided. On August 31 and September 1 heavy rains fell in the upper watershed of the Yadkin River in North Carolina, but coming after a rather long spell of dry weather only a moderate flood in the lower river resulted; meanwhile, stock and perishable property in the lowlands had been removed.

On the 8th heavy rains fell quite generally throughout the watershed of the North Branch of the Susquehanna, particularly in the neighborhood of Binghamton and to the westward as far as Elmira. The small streams in this region were filled to overflowing and much damage was done to crops and farm buildings along the streams. The damage in the city of Binghamton to buildings, streets, and gardens is said to have totaled $30,000.

On the 15th heavy rains again fell in the vicinity of Hornell, N. Y., and in Tioga and Bradford Counties, Pa., southeast of Hornell. Crops of buckwheat, corn, and oats suffered damage. Some loss was suffered by the railroads due to overflows. On the next day heavy rains again fell in Bradford County, Pa., in the vicinity of Troy, causing the streams to overflow their banks with considerable damage to bridges, culverts, and railroad tracks. Landslides added to the difficulty of maintaining railroad traffic.

Severe rainstorms, attended by intense electrical discharges, visited Syracuse, N. Y., on the 22d and in the neighborhood of Saint Johnsbury, Vt., on the 17th.

Property losses by flood (mostly estimated) in August, 1917.

District.	Tangible property, roads, bridges, etc.	Crops and gardens.	Live stock.	Suspension of business.
South central New York and northeastern Pennsylvania	$150,000	$20,000	$500	
Pee Dee Basin (N. C.)		500		$3,000
Bisbee, Ariz	50,000			
Total	180,000	20,500	500	3,000

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

TABLE 1.—*Floods in various rivers in the United States during August, 1917.*

River.	Station.	Flood stage.	Above flood stages—dates.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Tar	Greenville, N. C	13	(†)	3	14.6	†31
Alabama	Selma, Ala	35			30.8	10–11
Tallapoosa	Milstead, Ala	40	7	8	46.0	7
Cottonwood	Emporia, Kans	19			18.3	17
Smoky Hill	Lindsborg, Kans	20	16	17	22.6	17

† July.

MEAN LAKE LEVELS DURING AUGUST, 1916.

By UNITED STATES LAKE SURVEY.

[Dated: Detroit, Mich., Sept. 5, 1917.]

The following data are reported in the "Notice to Mariners" of the above date:

Data.	Lakes.*			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during August, 1917:	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Above mean sealevel at New York	602.69	581.90	573.57	247.35
Above or below—				
Mean stage of July, 1917	−0.04	−0.05	−0.29	−0.11
Mean stage of August, 1916	−1.00	−0.85	−0.75	−0.01
Average stage for August, last 10 years	−0.05	−1.10	−0.95	−0.75
Highest recorded August stage	−1.24	−1.61	−0.54	−0.91
Lowest recorded August stage	−1.09	−2.05	−2.19	−3.00
Average relation of the August level to—				
July level	−0.2	0.0	−0.2	−0.3
September level	−0.1	−0.2	−0.3	−0.4

* Lake St. Clair's level: in August, 576.62 feet.

SECTION V.—SEISMOLOGY.

SEISMOLOGICAL REPORTS FOR AUGUST, 1917.

W. J. HUMPHREYS, Professor in Charge.

[Dated: Weather Bureau, Washington, D. C., Oct. 2, 1917.]

TABLE 1.—*Noninstrumental earthquake reports, August, 1917.*

Day.	Approximate time, Greenwich Civil.	Station.	Approximate latitude.	Approximate longitude.	Intensity Rossi-Forel.	Number of shocks.	Duration.	Sounds.	Remarks.	Observer.
		CALIFORNIA.								
1917.	*H. m.*		° ′	° ′			*M. s.*			
Aug. 3	4 20	Cahuilla	33 32	116 43	4	1	0 3	Rumbling		Dr. Wm. L. Shawk.
19	6 00	Boulevard	32 38	116 15	3	1	1	None		J. J. Schwartzberg.
19	7 10	Julian	33 05	116 37	5	2	30	Rumbling		J. H. L. Vogt.
		Julian	33 03	116 37	.....	2	8	Rumbling		W. J. Norman.
28	0 35	Bishop	37 22	118 24	5	4	.....	None		E. L. Herzinger.
28	8 40	Bishop	37 22	118 24	4	1	1	.....	Awakened people	E. L. Herzinger.
		Bishop Creek	37 15	118 17	3	.....	.....	None		Wm. Barth.
31	19 20	Ojai	34 25	119 12	4	1	1	None		Wm. H. Duncan.
31	20 25	Ojai	34 25	119 12	4	1	1	None		Wm. H. Duncan.

TABLE 2.—*Instrumental reports, August, 1917.*

[Time used: Mean Greenwich, midnight to midnight. Nomenclature: International.]

[For significance of symbols see REVIEW for July, 1917, p. 373.]

Alaska. *Sitka. Magnetic Observatory.* U. S. Coast and Geodetic Survey. J. W. Green.

Lat., 57° 03′ 00″ N.; long., 135° 30′ 06″ W. Elevation, 15.2 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants...		*V*	T_0
	E	10	16.7
	N	10	15.4

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
Aug. 5	.....	e_N	16 42 22	21	.....	10	.....	
		F	16 58 ..	.....	.....	.....	.....	
30	.....	eP_E	4 25 07	.....	.....	.....	.....	
		eL_E	4 32 21	14	.....	.....	.....	
		eL_N	4 34 45	18	.....	.....	.....	
		M_E	4 35 01	14	40	.....	.....	
		M_N	4 40 20	18	.....	20	.....	
		F_N	5 35 ..	.....	.....	.....	.....	
31	.....	eP_E	11 47 44	.....	.....	.....	.....	
		eP_N	11 48 20	.....	.....	.....	.....	
		S	11 57 05	10	.....	.....	.....	
		eL_E	12 15 ..	18	.....	.....	.....	
		eL_N	12 16 ..	20	.....	.....	.....	
		M_N	12 20 02	17	.....	60	.....	
		C_N	12 27 ..	16	.....	.....	.....	
		M_E	12 28 42	15	10	.....	.....	
		C_E	12 29 ..	.....	.....	.....	.....	
		F_E	12 55 ..	.....	.....	.....	.....	
		F_N	13 02 ..	.....	.....	.....	.....	

Arizona. *Tucson. Magnetic Observatory.* U. S. Coast and Geodetic Survey. F. P. Ulrich.

Lat., 32° 14′ 48″ N.; long., 110° 50′ 06″ W. Elevation, 769.6 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants...		*V*	T_0
	E	10	13.9
	N	10	18.9

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
Aug. 30	.....	e_E	4 28 22	4	.....	.....	.....	
		e_N	4 28 44	5	.....	.....	.....	
		M_N	4 45 04	14	.....	10	.....	
		M_E	5 09 04	20	10	.....	.....	
		F_E	5 36 ..	.....	.....	.....	.....	
		F_N	5 45 ..	.....	.....	.....	.....	
31	.....	P	11 44 35	5	.....	.....	.....	
		S	11 51 20	8	.....	.....	.....	
		eL_N	11 58 00	28	.....	.....	.....	
		eL_E	11 59 02	28	.....	.....	.....	
		M_E	11 59 43	13	30	.....	.....	
		M_N	12 03 49	24	.....	20	.....	
		F_N	12 54 ..	.....	.....	.....	.....	
		F_E	13 04 ..	.....	.....	.....	.....	

California. *Berkeley. University of California.*

Lat., 37° 52′ 16″ N.; long., 122° 15′ 37″ W. Elevation, 85.4 meters.

(See Bulletin of the Seismographic Stations, University of California.)

TABLE 2.—*Instrumental reports, August, 1917*—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
California. *Mount Hamilton. Lick Observatory.* Lat., 37° 20′ 24″ N., long., 121° 38′ 34″ W. Elevation, 1,281.7 meters. (See Bulletin of the Seismographic Stations, University of California.)								
California. *Point Loma. Raja Yoga Academy.* F. J. Dick. Lat., 32° 43′ 03″ N.; long., 117° 15′ 10″ W. Elevation, 91.4 meters. Instrument: Two-component, C. D. West seismoscope. (Report for August, 1917, not received.)								
California. *Santa Clara. University of Santa Clara.* J. S. Ricard, S. J. Lat., 37° 26′ 36″ N.; long., 121° 57′ 03″ W. Elevation, 27.43 meters. (See record of the Seismographic Station, University of Santa Clara.)								
Colorado. *Denver. Sacred Heart College.* Earthquake Station. A. W. Forstall, S. J. Lat., 39° 40′ 36″ N.; long., 104° 56′ 54″ W. Elevation, 1,655 meters. Instrument: Wiechert 80 kg., astatic, horizontal pendulum. (No earthquake recorded during August, 1917.)								
District of Columbia. *Washington. U. S. Weather Bureau.* Lat., 38° 54′ 12″ N.; long., 77° 03′ 03″ W. Elevation, 21 meters. Instrument: Marvin (vertical pendulum, undamped. Mechanical registration). V 110, T_0 6.4								
1917. Aug. 5	I_T	P	*H. m. s.* 16 11 18	*Sec.*	μ	μ	*km.* 4,080?	
		S?	16 17 10					
		L	16 28 20	16				
		L	16 54 20					
		F	17 40 00					
9		P	16 18 ..					No time marks; values approximate.
		S	16 22 ..					
		L	16 24 ..					
		F	16 40 ..					
11								No record obtained; instrument not recording properly.
21		P	10 49 30					Time correction uncertain; time values approximate.
		L	11 10 30	16				
		F	11 30 ..					S uncertain.
22		L_E	22 13 30	20				
		F	22 25 00					
30		iP	3 31 06				3,910	
		iS	3 36 48					
		L	3 41 00					
		F	4 00 ..					
30		P	4 26 24				8,510?	
		PR	4 29 30					
		S?	4 36 10					
		L	4 47 15					
		L	5 05 00	24				
		L	5 21 00	20				
		F	6 30 00					
31	II_T	iP	11 43 14				3,740	
		iS	11 48 46					
		L	11 52 30	20				
		L	12 07 03	16				
		F	13 30 00					

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
District of Columbia. *Washington. Georgetown University.* F. A. Tondorf, S. J. Lat., 38° 54′ 25″ N.; long., 77° 04′ 24″ W. Elevation, 42.4 meters. Subsoil: decayed diorite. Instruments: Wiechert 200 kg. astatic horizontal pendulums, 80 kg. vertical. Instrumental constants: E: V 165, T_0 5.4, ϵ 0; N: 143, 5.2, 0; Z: *80*, *5.0*, *0*								
1917. Aug. 5		eP_E	*H. m. s.* 16 11 12	*Sec.*	μ	μ	*km.*	Microseisms present. P possibly earlier. No distinct maximum.
		eP_N	16 11 15					
		eL	16 54 18	24				
		F	17 45 ..					
			VERTICAL.					
		eP	*16 11 21*					e? 16h 09m 38s.
		eL	*16 54 21*	*20–24*				
		F	*17 50 00*					
11		eP_E?	14 44 06					Heavy microseisms present; entire record doubtful.
		eP_E?	14 44 36					
		S_N?	14 49 22					
		S_E?	14 49 43					
		eL_N?	15 00 21					
		eL_E?	15 00 23					
		F	16					
30		e_E	3 30 55					Microseisms present. e shows on vertical at 3h 31m 13s. F lost in succeeding quake.
		e_N	3 31 08					
		S_N	3 36 39					
		S_E	3 36 46					
		eL	3 39 24					
30		eP_E	4 26 28					Microseisms present. No distinct maximum.
		eP_N	4 26 29					
		S	4 30 05					
		eL_E	4 31 18					
		eL_N	4 31 30					
		L	4 58 ..	30				
		F	6 22 ..					
			VERTICAL.					
		eP	*4 26 50*					
		S	*4 30 05*					
		L	*4 42 20*	*21*				
		L	*5 20 48*	*22*				
		F	*5 40* ..					
31		iP_N	11 43 19					Microseisms present.
		eP_E	11 43 21					
		iS	11 48 49					
		eL?	11 51 30					
		M_E	11 54 17		*1700			
		M_N	11 54 43			*600		
		F	13 54 ..					
			VERTICAL.					
		eP	*11 43 22*					
		L	*11 56* ..					
		F	*12 25* ..					

* Trace amplitude.

Hawaii. *Honolulu. Magnetic Observatory.* U. S. Coast and Geodetic Survey. Frank Neuman.
Lat., 21° 19′ 12″ N.; long., 158° 03′ 48″ W. Elevation, 15.2 meters.
Instrument: Milne seismograph of the Seismological Committee of the British Association.
T_0
Instrumental constant.. 18.5
(Report for August, 1917, received too late.)

Kansas. *Lawrence. University of Kansas.* Department of Physics and Astronomy. F. E. Kester.
Lat., 38° 57′ 30″ N.; long., 95° 14′ 58″ W. Elevation, 301.1 meters.
Instrument: Wiechert.
Instrumental constants: E: V 177, T_0 3.4, ϵ 4.1; N: 205, 3.4, 4.1
(Report for August, 1917, not received.)

TABLE 2.—*Instrumental reports, August, 1917*—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.

Maryland. *Cheltenham. Magnetic Observatory.* U. S. Coast and Geodetic Survey. George Hartnell.

Lat., 38° 44′ 00″ N.; long., 76° 50′ 30″ W. Elevation, 71.6 meters.
Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants..	V	T_0
E	10	32
N	10	27

1917			H. m. s.	Sec.	μ	μ	km.	
Aug. 30	.....	eP.....	4 26 44	2	.....	.....	.....	
		eS_N.....	4 30 20	2	.....	.....	.....	
		eS_E.....	4 30 26	2	.....	.....	.....	
		M_E.....	4 36 28	6	20	.....	.....	
		C_E.....	4 40 ..	.....	.....	.....	.....	
		F_N.....	6 10 ..	.....	.....	.....	.....	
31	.....	P.....	11 43 18	4	.....	.....	.....	
		S.....	11 48 52	8	.....	.....	.....	
		eL_E.....	11 53 25	12	.....	.....	.....	
		M_N.....	11 57 22	16	.....	140	.....	
		M_E.....	11 58 01	16	80	.....	.....	
		C.....	12 09 ..	15	.....	.....	.....	
		F.....	12 41 ..	.....	.....	.....	.....	

Massachusetts. *Cambridge. Harvard University Seismograph Station.* J. B. Woodworth.

Lat., 42° 22′ 36″ N.; long., 71° 06′ 59″ W. Elevation, 5.4 meters. Foundation: Glacial sand over clay.

nstruments: Two Busch-Omori 100 kg. horizontal pendulums (mechanical registration).

Instrumental constants..	V	T_0	e
E	80	23	0
N	50	25	4:1

1917			H. m. s.	Sec.	μ	μ	km.	
Aug. 5	.....	*O*?....	*15 45* ..	.....	.....	.....	13,000+	
		e_E?....	15 59 58	.....	.....	.....	.....	
		eS_E....	16 12 51	10	.....	.....	.....	
		eL_E....	16 59 17	24	.....	.....	.....	
		L.....	17 02 33	18	.....	.....	.....	Sinusoidals set in.
		L.....	17 06 51	18	.....	.....	.....	
		L.....	17 16 14	15	.....	.....	.....	
		L.....	17 49 25	15	.....	.....	.....	
		F.....	18 49 ..	.....	.....	.....	.....	
5	.....	L_E....	20 00 16	20	.....	.....	.....	Possibly LR of preceding quake.
		L.....	20 24 40	20	.....	.....	.....	
		F.....	20 58 ..	.....	.....	.....	.....	
5	.....	L_E....	23 22 49	12–14	.....	.....	.....	This and the next possibly LR of first quake.
		F.....	23 29 31	.....	.....	.....	.....	
6	.....	L_E....	1 18 51	12	.....	.....	.....	
		L_E....	1 22 38	12	.....	.....	.....	
		F.....	1 25 37	.....	.....	.....	.....	
21	.....	L_E....	22 13 37	24–18	.....	.....	.....	E–W component stopped at 22h, 27m, 53s.
		L_N....	22 15 48	24	.....	.....	.....	
		F?....	22 27 17	.....	.....	.....	.....	
30	.....	*O*?....	*3 23 36*	.....	.....	.....	4,340?	L–S_E interval gives 4425km eL_E—*O* gives speed of L as as 230km. per minute. F lost in succeeding quake.
		P_E?....	3 31 18	3	.....	.....	.....	
		S_E.....	3 37 24	9	.....	.....	.....	
		S_N.....	3 37 51	6	.....	.....	.....	
		eL_E....	3 42 26	24	.....	.....	.....	
		eL_N....	3 42 18	.....	.....	.....	.....	
		L_N.....	3 46 16	16	.....	.....	.....	
30	.....	*O*.....	*4 06 22*	.....	.....	.....	7,550	
		eS_E....	4 26 17	8	.....	.....	.....	
		S_N.....	4 26 40	6	.....	.....	.....	
		iSR_E?..	4 29 53	12	.....	.....	.....	
		iSR_N....	4 30 24	14	.....	.....	.....	
		eL_E....	4 39 26	12	.....	.....	.....	Followed by a long series of irregular L waves.
		eL_N....	4 40 23	.....	.....	.....	.....	
		F.....	5 46 ..	.....	.....	.....	.....	
31	.....	*O*.....	*11 36 33*	.....	.....	.....	4,120	
		P_N.....	11 44 00	.....	.....	.....	.....	
		P_E.....	11 44 07	.....	.....	.....	.....	
		iS_N....	11 49 54	.....	.....	.....	.....	First movement pendulum to north. First movement of pendulum in iS_E to east.
		iS_E....	11 50 27	6	.....	.....	.....	
		SR2....	11 52 57	10	.....	.....	.....	
		eL_E?..	11 54 29	24	.....	.....	.....	
		eL_N....	11 54 36	.....	.....	.....	.....	
		M_N.....	11 59 42	.....	.....	.....	.....	
		M_E.....	11 59 48	.....	.....	.....	.....	
		M_E.....	12 01 56	.....	.....	.....	.....	
		F_E.....	13 56 ..	.....	.....	.....	.....	

Missouri. *Saint Louis. St. Louis University.* Geophysical Observatory. J. B. Goesse, S. J.

Lat., 38° 38′ 15″ N.; long., 90° 13′ 58″ W. Elevation, 160.4 meters. Foundation: 12 feet of tough clay over limestone of Mississippi system, about 300 feet thick.

Instrument: Wiechert, 80 kg. astatic, horizontal pendulum.

Instrumental constants..	V	T_0	e
	80	7	5:1

1917.			H. m. s.	Sec.	μ	μ	km.	
Aug. 30	I.....	e_N.....	16 27 30	.....	.....	.....	.....	Barely perceptible.
		F_N.....	16 33 ..	.....	.....	.....	.....	
31	II_N....	iP_E....	11 47 00	.....	.....	.....	.....	
		iP_N....	11 47 45	.....	.....	.....	.....	
		S_E.....	11 56 30	.....	.....	.....	.....	
		S_N.....	11 57 00	.....	.....	.....	.....	
		M_N.....	11 58 30	.....	.....	63	.....	
		M_E.....	12 00 06	.....	.....	.....	.....	
		F_E.....	12 22 ..	.....	.....	.....	.....	
		F_N.....	12 30 ..	.....	.....	.....	.....	

New York. *Buffalo. Canisius College.* John A. Curtin, S. J.

Lat., 42° 53′ 02″ N.; long., 78° 52′ 40″ W. Elevation, 190.5 meters.

Instrument: Wiechert 80 kg. horizontal.

Instrumental constants..	V	T_0	e
	80	7	5:1

(Report for August, 1917, not received.)

New York. *Fordham. Fordham University.* Daniel H. Sullivan, S. J.

Lat., 40° 51′ 47″ N.; long., 73° 53′ 08″ W. Elevation, 23.9 meters.

Instrument: Wiechert, 80 kg.

Instrumental constants..	V	T_0	e
E	72	6.6	1.5:1
N	72	7.1	3.8:1

(Report for August, 1917, not received.)

New York. *Ithaca. Cornell University.* Heinrich Ries.

Lat., 42° 26′ 58″ N.; long., 76° 29′ 09″ W. Elevation, 242.6 meters.

Instruments: Two Bosch-Omori, 25 kg., horizontal pendulums (mechanical registration).

Instrumental constants..	V	T_0	e
E	13	22	4:1
N	14	25	4:1

1917.			H. m. s.	Sec.	μ	μ	km.	
Aug. 3	.....	e_N.....	22 48 32	4	.....	.....	.....	Absolute times inaccurate throughout month. Repairs being made in seismograph room. Master clock not running.
		e_N.....	22 51 36	4	.....	.....	.....	
		L_N.....	23 01 52	44	.....	.....	.....	
		F_N.....	23 42 ..	.....	.....	.....	.....	
5	.....	eL_E....	16 53 50	22	.....	.....	.....	
		eL_E....	16 54 40	27	.....	.....	.....	
		F_E.....	17 22 ..	.....	.....	.....	.....	
		F_N.....	17 26 ..	.....	.....	.....	.....	
30	.....	eP_N....	3 30 12	3	.....	.....	.....	
		S_N.....	3 36 12	6	.....	.....	.....	
		e_N.....	3 40 20	7	.....	.....	.....	
		eL_N....	3 44 10	16	.....	.....	.....	
		F_N.....	4 17 ..	.....	.....	.....	.....	
30	.....	e_N.....	4 26 16	4	.....	.....	.....	
		i_N.....	4 28 40	3	.....	.....	.....	
		L_N.....	4 46 03	13	.....	.....	.....	
		L_N.....	5 01 32	34	.....	.....	.....	
		F_N.....	6 17 ..	.....	.....	.....	.....	
31	.....	P_N.....	11 43 15	3	.....	.....	.....	
		S_N.....	11 49 05	6	.....	.....	.....	
		M_N.....	12 00 14	19	.....	*1,000	.....	
		F_N.....	13 20 ..	.....	.....	.....	.....	

*Trace amplitude.

TABLE 2.—*Instrumental reports, August, 1917*—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Panama Canal Zone. *Balboa Heights.* Isthmian Canal Commission. Lat., 8° 57′ 39″ N.; long., 79° 33′ 29″ W. Elevation, 27.6 meters. Instruments: Two Bosch-Omori, 100 kg. Instrumental constants.. V 10, T_0 20								
1917. Aug. 30	.....	P_E	H. m. s. 3 26 08	Sec.	μ	μ	km. 950	Direction probably south.
		P_N	3 26 10					
		L_N	3 28 10					
		L_E	3 28 20					
		M_E	3 28 42		*1500			
		M_N	3 28 54			*3000		
		F_E	3 47 00					
		F_N	3 51 00					
31	.....	P_E	11 38 08				910	Direction probably south.
		P_N	11 38 12					
		S	11 39 44					
		L_E	11 40 10					
		L_N	11 40 12					
		M_N	11 40 49			*62000		
		M_E	11 41 52		*46000			
		F_E	12 34 00					
		F_N	12 36 00					
Porto Rico. *Vieques.* *Magnetic Observatory.* U. S. Coast and Geodetic Survey. F. L. Adams. Lat., 18° 08′ 48″ N.; long., 65° 26′ 54″ W. Elevation, 19.8 meters. Instruments: Two Bosch-Omori. Instrumental constants.. V: E 10, N 10; T_0: E 17.5, N 18.2								
1917. Aug. 7	.....	e_N	H. m. s. 11 27 53	Sec.	μ	μ	km.	Local quake.
		e_E	11 28 15					
		eL	11 28 40	2				
		M_N	11 28 50			20		
		M_E	11 28 55		20			
		F	11 35 ..					
9	.....	eP_E	16 15 26					Very small waves superimposed on others having a period of 6 to 10 seconds.
		eP_E	16 15 31					
		eL_N	16 16 25					
		eL_E	16 16 35	6				
		M_E	16 16 40	7	50			
		M_N	16 16 50	7		40		
		C	16 20 ..	6				
		F	16 26 ..					
30	.....	eP_E	3 28 18	4				
		eL_E	3 33 33	17				
		M_E	3 34 24	17	70			
		M_N	3 35 20	18		20		
		C_E	3 41 ..	13				
		F_E	3 52 ..					
31	.....	eP_N	11 40 17	4				The drums were taken off to change the paper at 12h 22m, while the quake was still in progress.
		eP_E	11 40 23	4				
		eS_N	11 43 42	8				
		eL_E	11 44 15	30				
		eL_N	11 45 23	19				
		M_N	11 48 10	21		*3090		
		M_E	11 49 55	17	*3520			
		C_E	12 00 ..					
Vermont. *Northfield.* *U. S. Weather Bureau.* Wm. A. Shaw. Lat., 44° 10′ N.; long., 72° 41′ W. Elevation, 256 meters. Instruments: Two Bosch-Omori, mechanical registration. Instrumental constants.. V: E 10, N 10; T_0: E 15, N 16								
1917. Aug. 5	.....	e_E	H. m. s. 16 11 58	Sec.	μ	μ	km.	Does not show on N-S.
		L_E	16 57 00	20				
		L_E	17 11 00	20				
		F	17 30 ..					F in microseisms.
30	.....	P	4 26 36				7,780?	
		PR	4 29 36					
		S?	4 35 45					
		L	4 47					
		L	5 12 ..	20				
		F	6 15 ..					
31	II_r	iP	11 44 00				4,120?	
		S?	11 49 54					
		L	11 53 00					
		L_N	11 59 50	20				
		L_E	12 03 15	20				
		F	12 45 ..					

* Trace amplitude.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Canada. *Ottawa.* *Dominion Astronomical Observatory.* Earthquake Station. Otto Klotz. Lat., 45° 23′ 38″ N.; long., 75° 42′ 57″ W. Elevations, 83 meters. Instruments: Two Bosch photographic horizontal pendulums, one Spindler & Hoyer 80k. vertical seismograph. Instrumental constants., V 120, T_0 26								
1917. Aug. 5	.....	O	H. m. s. *15 50 48*	Sec.	α	α	km. 14,000	In New Zealand, from press reports.
		e_N	16 09 52					
		iPR1	16 11 45					
		iS	16 21 50	8				
		e_N	16 29 ..	11				
		e_E	16 30 ..	20				
		L	16 51 ..	15				From 16h 50m onwards the L waves are more or less continually sinuous.
		L	17 00 ..	18–19				
		L	17 08 ..	17				
		L	17 11 ..	17				
		L	17 17 ..	15				
		L	17 27 ..	15				
		L	17 35 ..	15				
		LR1	17 56 ..	20				
		F	18 10 ..					
9	.....	eL_N	16 30 ..	14				
		L_N	16 40 ..	14				
		F	17 00 ..					
21	.....	O?	*10 44 32*				4,450?	
		eP?	10 52 22					
		eS	10 58 34					
		eL_N	11 06 36	20				
		L	11 09 ..	14				
		F	11 25 ..					
21	.....	L	22 17 ..	20–22				
		F	22 30 ..					
30	.....	O	*3 24 10*				4,530	Fairly strong microseisms prevail.
		iP	3 32 06	2				
		iS	3 38 22					
		eL?	3 41 18	16				
		L	3 51 ..					
		F	4 07 ..					
30	.....	O	*4 15 36*				7,650	
		P	4 26 38					
		iPR1	4 29 53					
		PR2	4 31 11					
		S	4 35 40					
		eL	4 48 18	20				
		L	4 53 ..	20				
		L	5 03 ..	15				
		L	5 20 ..	20				
		L	5 33 ..	17				
		L	5 49 ..	17				
		LR1?	6 06 ..	30				
		F	6 35 ..					
31	.....	O	*11 36 20*				4,470	In Colombia.
		iP_N	11 44 12	2–4				
		iS	11 50 25	6–8				
		eL_E	11 56 30	20				
		eL_N	11 57 ..	20				
		L	12 02 ..	20				
		L	12 05 ..	16–15				
		L	12 13 ..	16–15				
		L	12 24 ..	15				
		L	12 44 ..	13				
		F	13 10 ..					

Canada. *Toronto.* *Dominion Meteorological Service.*

Lat., 43° 40′ 01″ N.; long., 79° 23′ 54″ W. Elevation, 113.7 meters. Subsoil: Sand and clay.

Instrument: Milne horizontal pendulum, North; in the meridian.

Instrumental constant.. T_0 18. Pillar deviation, 1 mm. swing of boom=0.50″.

(Report for August, 1917, not received.)

Canada. *Victoria, B. C.* *Dominion Meterological Service.*

Lat., 48° 24′ N.; long., 123° 19′ W. Elevation, 67.7 meters. Subsoil: Rock.

Instruments: Wiechert, vertical. Milne horizontal pendulum, North; in the meridian.

Instrumental constant.. T_0 18. Pillar deviation: 1 mm. swing of boom=0.54″.

(Report for August. 1917, not received.)

TABLE 3.—*Late seismological reports (instrumental).*

Hawaii. *Honolulu. Magnetic Observatory.* U. S. Coast and Geodetic Survey. Frank Neuman.

Lat., 21° 19′ 12″ N.; long., 158° 03′ 48″ W. Elevation, 15.2 meters.

Instrument: Milne seismograph of the Seismological Committee of the British Association.

T_0
Instrumental constant.. 18.5

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1917. July 1	.....	eL	1 10 30	20	.....	.....	.....	Only E–W motion recorded.
		M	1 18 00	.....	*200	.....	.....	
		C	1 21 12	.....	.....	.....	.....	
		F	1 26 ..	.....	.....	.....	.....	
4	.....	eP	0 50 18	.....	.....	.....	.....	Trace in jerks. Waves indistinct.
		eS	0 56 48	.....	.....	.....	.....	
		eL	1 11 54	21	.....	.....	.....	
		M	1 22 18	.....	*2100	.....	.....	
		C	1 29 00	.....	.....	.....	.....	
		F	2 14 ..	.....	.....	.....	.....	
4	.....	eP	5 57 00	.....	.....	.....	.....	Trace in jerks. Waves indistinct.
		L	6 11 12	.....	.....	.....	.....	
		M	6 20 12	.....	*600	.....	.....	
		C	6 27 ..	.....	.....	.....	.....	
		F	6 56 ..	.....	.....	.....	.....	
4	.....	eL	22 57 42	.....	.....	.....	.....	
		M	23 12 ..	20	*100	.....	.....	
		C	23 15 ..	.....	.....	.....	.....	
		F	23 19 ..	.....	.....	.....	.....	
7	.....	.....	.....	.....	.....	.....	.....	Light failed on the the 7th from 13^h 40^m to 18^h 33^m.
11	.....	L	22 59 00	.....	.....	.....	.....	
		M	23 05 18	19	*700	.....	.....	
		C	23 08 ..	.....	.....	.....	.....	
		F	23 29 ..	.....	.....	.....	.....	
12	.....	eP	11 51 48	.....	.....	.....	.....	
		eL	12 09 30	21	.....	.....	.....	
		M	12 13 12	.....	*800	.....	.....	
		C	12 18 ..	.....	.....	.....	.....	
		F	13 50 ..	.....	.....	.....	.....	
18	.....	P	8 08 48	.....	.....	.....	.....	
		eL	8 16 54	23	.....	.....	.....	
		M	8 24 12	20	*300	.....	.....	
		C	8 29 ..	.....	.....	.....	.....	
		F	9 11 ..	.....	.....	.....	.....	
25	.....	L	3 31 06	.....	.....	.....	.....	
		M	3 37 00	18	*400	.....	.....	
		C	3 41 12	.....	.....	.....	.....	
		F	5 12 ..	.....	.....	.....	.....	
25	.....	L	22 46 ..	18	.....	.....	.....	
		M	22 54 48	.....	*100	.....	.....	
		F	23 03 ..	.....	.....	.....	.....	
27	.....	P	1 13 54	.....	.....	.....	.....	
		S	1 24 18	.....	.....	.....	.....	
		L	1 41 18	21	.....	.....	.....	
		M	1 49 42	19	*1600	.....	.....	
		C	2 02 ..	.....	.....	.....	.....	F in next quake.
27	.....	L	3 37 24	22	.....	.....	.....	P and S lost in preceding quake.
		M	3 42 06	.....	*3400	.....	.....	
		C	3 50 00	.....	.....	.....	.....	
		F	6 00 ..	.....	.....	.....	.....	
27	.....	eP	23 54 00	.....	.....	.....	.....	
28		eL	0 04 36	18	.....	.....	.....	
		M	0 10 00	.....	*700	.....	.....	
		C	0 13 00	.....	.....	.....	.....	
		F	0 48 ..	.....	.....	.....	.....	
29	.....	eP	14 42 12	.....	.....	.....	.....	
		S	14 49 42	.....	.....	.....	.....	
		eL	14 57 24	18	.....	.....	.....	
		M	14 50 00	.....	*600	.....	.....	
		M	15 15 24	.....	*400	.....	.....	
		F	16 28 ..	.....	.....	.....	.....	
29	.....	P	22 03 54	.....	.....	.....	.....	
		S	22 12 12	.....	.....	.....	.....	
		L	22 22 30	22	.....	.....	.....	
		M	22 29 00	.....	*13000	.....	.....	
		C	23 18 ..	.....	.....	.....	.....	
30		F	2 15 ..	.....	.....	.....	.....	
30	.....	eL	16 55 00	.....	.....	.....	.....	
		M	16 58 48	18	*200	.....	.....	
		F	17 17 ..	.....	.....	.....	.....	

* Trace amplitude.

Hawaii. *Honolulu. Magnetic Observatory*—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
31	.....	eP	0 16 18	.....	.....	.....	.....	
		eL	0 30 36	18	.....	.....	.....	
		M	0 53 12	.....	*900	.....	.....	
		C	0 58 00	.....	.....	.....	.....	
		F	1 39 ..	.....	.....	.....	.....	
31	.....	eP	3 33 06	.....	.....	.....	.....	
		eL	3 46 54	20	.....	.....	.....	
		M	3 50 18	.....	*1600	.....	.....	
		C	3 52 ..	.....	.....	.....	.....	
		F	4 45 ..	.....	.....	.....	.....	

* Trace amplitude.

Panama Canal Zone. *Balboa Heights.* Isthmian Canal Commission.

Lat., 8° 57′ 39″ N.; long., 79° 33′ 29″ W. Elevation, 27.6 meters.

Instruments: Two Bosch-Omori, 100 kg.

V T_0
Instrumental constants.. 10 20

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1917. May 1	.....	P_N	18 43 20	.....	.....	.....	5,310	Direction?
		P_E	18 43 37	.....	.....	.....	.....	
		S_N	18 51 04	.....	.....	.....	.....	
		S_E	18 51 24	.....	.....	.....	.....	
		L_N	18 59 10	.....	.....	.....	.....	
		L_E	18 59 32	.....	.....	.....	.....	
		M_E	19 24 10	.....	*3,000	.....	.....	
		M_N	19 35 50	.....	.....	*1,500	.....	
		F_E	21 01 00	.....	.....	.....	.....	
		F_N	21 54 00	.....	.....	.....	.....	

* Trace amplitude.

Canada. *Toronto. Dominion Meteorological Service.*

Lat., 43° 40′ 01″ N.; long., 79° 23′ 54″ W. Elevation, 113.7 meters. Subsoil: Sand and clay.

Instrument: Milne horizontal pendulum, North; in the meridian.

T_0
Instrumental constant.. 18. Pillar deviation, 1 mm. swing of boom=0.50″.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
1917. July 1	.....	P?	13 27 48	.....	.....	.....	5,220?	Felt in south end of Graham Island in Queen Charlotte Islands.
		S	13 34 42	.....	.....	.....	.....	
		L	13 38 48	.....	.....	.....	.....	
		M	13 39 06	.....	*200	.....	.....	
		F	13 53 12	.....	.....	.....	.....	
4	.....	S?	1 04 30	.....	.....	.....	.....	Distant quake.
		eL	1 12 06	.....	.....	.....	.....	
		L	1 25 12	.....	.....	.....	.....	
		L	1 31 18	.....	.....	.....	.....	
		M	1 38 18	.....	*400	.....	.....	
		F	2 44 12	.....	.....	.....	.....	
4	.....	P or S	6 29 24	.....	.....	.....	.....	Distant quake.
		L	6 39 48	.....	.....	.....	.....	
		M	6 54 00	.....	*200	.....	.....	
		F	7 14 30	.....	.....	.....	.....	
9	.....	L	0 17 48	.....	.....	.....	.....	
		L	0 55 30	.....	*50	.....	.....	
11	.....	eL	23 34 36	.....	.....	.....	.....	Quake and tidal wave reported from the Samoan Islands; damage done. Also felt in Friendly Is.
		eL	23 40 12	.....	.....	.....	.....	
		M	23 43 00	.....	*300	.....	.....	
12		F	0 05 30	.....	.....	.....	.....	
12	.....	L	13 57 54	.....	*50	.....	.....	
		F	14 06 18	.....	.....	.....	.....	
13	.....	P?	5 27 30	.....	.....	.....	.....	
		L?	5 30 24	.....	.....	.....	.....	
		M	5 35 18	.....	*50	.....	.....	
		F	5 42 24	.....	.....	.....	.....	
15	.....	.....	.....	.....	.....	.....	.....	No record obtained on 15th; clock stopped.
21	.....	P	3 24 12	.....	.....	.....	.....	
		S	3 35 42	.....	.....	.....	.....	
		L	3 47 06	.....	.....	.....	.....	
		iL	3 50 18	.....	.....	.....	.....	
		M	3 51 36	.....	*1,800	.....	.....	
		L_{sup}	5 01 36	.....	.....	.....	.....	
		F?	5 18 36	.....	.....	.....	.....	

*Trace amplitude.

TABLE 3.—*Late seismological reports (instrumental)*—Continued.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Canada. *Toronto.* *Dominion Meteorological Service*—Continued.								
			H. m. s.	*Sec.*	μ	μ	*km.*	
25	.....	P	22 42 42	.....	.....	.....	.....	
		S?	22 52 54	.....	.....	.....	.....	
		L	23 01 42	.....	.....	.....	.....	
		eL	23 03 18	.....	.....	.....	.....	
		M	23 04 24	.....	*300	.....	.....	
		F?	23 31 24	.....	.....	.....	.....	
27	.....	P	1 06 54	.....	.....	.....	2,990	
		S	1 11 36	.....	.....	.....	.....	
		L	1 13 24	.....	.....	.....	.....	
		iL	1 17 06	.....	.....	.....	.....	
		iL	1 18 00	.....	.....	.....	.....	
		M	1 21 06	.....	*9,300	.....	.....	F merges into next quake.
27	.....	P?	3 01 42	.....	.....	.....	10,740?	A quake of much intensity reported from Chile.
		iS	3 13 12	.....	.....	.....	.....	
		L	3 25 30	.....	.....	.....	.....	
		L	3 41 00	.....	.....	.....	.....	
		M	3 48 00	.....	*800	.....	.....	
		L_{rep}	4 54 30	.....	.....	.....	.....	
		F	5 36 12	.....	.....	.....	.....	
27	.....	P	16 20 24	.....	.....	.....	3,810	
		S	16 26 00	.....	.....	.....	.....	
		L	16 28 24	.....	.....	.....	.....	
		M	16 28 48	.....	*300	.....	.....	
		F	17 14 12	.....	.....	.....	.....	
28	.....	L	0 40 06	.....	.....	.....	.....	Thickenings.
		L	0 47 54	.....	.....	.....	.....	
		F	1 06 30	.....	.....	.....	.....	
28	.....	eL	1 44 24	.....	.....	.....	.....	
		M	1 45 42	.....	*200	.....	.....	
		F	1 57 48	.....	.....	.....	.....	
29	.....	P	{14 51 54 14 55 54}	.....	.....	.....	.....	Possibly two quakes overlapping.
		S?	15 08 36	.....	.....	.....	.....	
		eS	15 19 42	.....	.....	.....	.....	
		L	15 21 48	.....	.....	.....	.....	
		iL	15 25 00	.....	.....	.....	.....	
		M	15 28 36	.....	*1,600	.....	.....	
		F	16 53 18	.....	.....	.....	.....	
29	.....	P?	22 11 42	.....	.....	.....	11,330?	
		iP	22 15 24	.....	.....	.....	.....	
		iS	22 23 36	.....	.....	.....	.....	
		iS	22 31 18	.....	.....	.....	.....	
		L	22 35 36	.....	.....	.....	.....	
		L	22 59 12	.....	.....	.....	.....	
		M	23 08 48	18–48	*4,300	.....	.....	
		eL	23 16 06	.....	.....	.....	.....	
		L_{rep}	23 56 00	.....	.....	.....	.....	Either L_{rep} or another quake.
30		iL	0 02 12	.....	.....	.....	.....	
		iL	0 05 48	18	*2,500	.....	.....	F lost in microseisms.
30	.....	L	17 31 00	.....	.....	.....	.....	
		L	17 35 36	.....	.....	.....	.....	F?.
31	.....	P?	0 21 06	.....	.....	.....	.....	Strong microseisms going on.
		S?	0 29 00	.....	.....	.....	.....	
		L	0 41 12	.....	.....	.....	.....	
		L	0 46 00	.....	.....	.....	.....	
		M	0 58 12	.....	*900	.....	.....	
		L	1 30 12	.....	.....	.....	.....	F in microseisms.
31	.....	P?	3 25 12	.....	.....	.....	7,380?	Microseisms going on.
		S	3 34 00	.....	.....	.....	.....	
		L	3 45 48	.....	.....	.....	.....	
		M	3 46 00	.....	*400	.....	.....	
		L	3 59 00	.....	.....	.....	.....	
		eL	4 34 12	.....	.....	.....	.....	F in microseisms.

* Trace amplitude.

Canada. *Victoria, B. C.* *Dominion Meteorological Service.*

Lat., 48° 24′ N.; long., 123° 19′ W. Elevation, 67.7 meters. Subsoil: Rock.
Instruments: Wiechert, vertical. Milne horizontal pendulum, North; in the meridian.
Instrumental constant.. $\frac{T_0}{18}$. Pillar deviation: 1 mm. swing of boom=0.54″.

1917.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
			H. m. s.	*Sec.*	μ	μ	*km.*	
July 1	.....	P	13 21 37	.....	.....	.....	.....	Felt at south end of Graham Island in Queen Charlotte Islands, Wireless operator reported sharp quake at $13^h\ 20^m$.
		S or L	13 22 17	.....	.....	.....	.....	
		M	13 23 06	.....	*600	.....	.....	
		F	13 32 26	.....	.....	.....	.....	
			VERTICAL.		A_E			
		P	*13 21 37*	*2*	.....	.....	.....	
		L	*13 22 37*	*3–4*	.....	.....	.....	
		M	*13 22 55*	*6*	*1*	.....	.....	
		F	*13 27 55*	.....	.....	.....	.....	

* Trace amplitude.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Canada. *Victoria, B. C.* *Dominion Meteorological Service*—Con.								
			H. m. s.	*Sec.*	μ	μ	*km.*	
4	.....	P	0 50 42	.....	.....	.....	9,190	Probably in Chile or Philippines.
		S	1 01 02	.....	.....	.....	.....	
		L	1 18 15	.....	.....	.....	.....	
		M	1 41 51	.....	*500	.....	.....	
		F	2 28 05	.....	.....	.....	.....	
4	.....	L	6 29 04	.....	.....	.....	.....	
		M	6 40 22	.....	*200	.....	.....	
9	.....	P?	0 47 58	.....	.....	.....	.....	
		L	0 50 27	.....	.....	.....	.....	
		M	0 51 27	.....	*200	.....	.....	
		F	0 54 55	.....	.....	.....	.....	
11	.....	P?	23 14 54	.....	.....	.....	.....	
		L	23 17 23	.....	.....	.....	.....	
		M	23 22 20	.....	*300	.....	.....	
		F	23 34 14	.....	.....	.....	.....	
12	.....	P	12 06 57	.....	.....	.....	4,120	
		S	12 12 51	.....	.....	.....	.....	
		L	12 23 10	.....	.....	.....	.....	
		M	12 31 47	.....	*600	.....	.....	
		F	12 59 34	.....	.....	.....	.....	
12	.....	L?	13 27 06	.....	.....	.....	.....	Probably distinct from above.
		M	13 30 03	.....	*200	.....	.....	
		F	13 37 55	.....	.....	.....	.....	
15	.....	P?	11 37 52	.....	.....	.....	.....	
		L?	11 44 18	.....	.....	.....	.....	
		M	11 48 20	.....	*300	.....	.....	
		F	12 14 37	.....	.....	.....	.....	
25	.....	P	3 25 50	.....	.....	.....	1,710	
		S	3 28 47	.....	.....	.....	.....	
		L	3 30 45	.....	.....	.....	.....	
		M	3 32 43	.....	*1,500	.....	.....	
		F	4 32 43	.....	.....	.....	.....	
			VERTICAL.		A_E			
		P	*3 25 30*	*3*	.....	.....	*2,080*	
		S	*3 29 00*	*4–6*	.....	.....	.....	
		L	*3 31 42*	*18–20*	.....	.....	.....	
		M	*3 32 30*	*20*	*10*	.....	.....	
		F	*3 48 00*	.....	.....	.....	.....	
27	.....							[Other components lost; clock stopped.]
			VERTICAL.		A_E			
		P	*1 10 28*	*5–6*	.....	.....	*9,000*	
		S	*1 20 48*	*12*	.....	.....	.....	
		L	*1 29 42*	*18*	.....	.....	.....	
		M	*1 36 18*	*18*	*8*	.....	.....	
		F	*2 16 00*	.....	.....	.....	.....	
27	.....	M	3 44 56	.....	*3,500	.....	.....	Earlier records missed; clock stopped.
		F	5 36 17	.....	.....	.....	.....	
			VERTICAL.		A_E			
		L	*5 56 00*	*18–20*	.....	.....	.....	
		M	*5 41 00*	*20*	.....	.....	.....	*F?*.
27	.....	S?	16 42 48	.....	.....	.....	.....	
		L	16 48 30	.....	.....	.....	.....	
		M	16 54 06	.....	*100	.....	.....	
		F	17 08 42	.....	.....	.....	.....	
28	.....							Clock stopped on 28th.
29	.....	P	14 51 27	.....	.....	.....	5,730	
		S	14 58 49	.....	.....	.....	.....	
		L	15 05 43	.....	.....	.....	.....	
		M	15 10 53	.....	*400	.....	.....	
		F	16 17 31	.....	.....	.....	.....	
29	.....	P?	22 06 43	.....	.....	.....	7,420?	P uncertain.
		S	22 15 34	.....	.....	.....	.....	
		L	22 35 14	.....	.....	.....	.....	
		M	22 50 58	.....	*3,500	.....	.....	
30	.....	L_{rep}	0 25 24	.....	*1,500	.....	.....	
		F	1 16 33	.....	.....	.....	.....	
			VERTICAL.		A_E			
		P	*22 04 24*	*3–6*	.....	.....	*12,400*	
		S	*22 17 00*	*6–8*	.....	.....	.....	
		L	*22 35 06*	*30–32*	.....	.....	.....	
		M	*22 45 00*	*24*	*16*	.....	.....	*F?*.
30	.....	M	17 21 29	.....	*50	.....	.....	Thickening.
31	.....	P or S.	3 33 47	.....	.....	.....	.....	
		L	3 40 09	.....	.....	.....	.....	
		M	4 22 28	.....	*200	.....	.....	
		F	4 39 41	.....	.....	.....	.....	
31	.....	P?	0 36 14	.....	.....	.....	7,420	
		S	0 45 05	.....	.....	.....	.....	
		L	0 50 00	.....	.....	.....	.....	
		M	0 58 51	.....	*600	.....	.....	
		F	1 40 10	.....	.....	.....	.....	

* Trace amplitude.

SEISMOLOGICAL DISPATCHES.[1]

Belated dispatch, June 24, 1917.

Mount Etna broke into an unusual volcanic action yesterday at about 10:30 p. m. (true local time, 9:30 p. m.). The northeastern crater, which was formed in 1911, ejected reddish smoke and incandescent lapilli for about 30 minutes. Spurts of flames continued at intervals for several hours after the ejection of solid matter ceased. A similar phenomenon occurred in 1900 from the central crater. The northeastern crater is about 10,000 feet above sea level; the highest point of the volcano is about 10,750 feet. The matter ejected reached a maximum height of about 1,000 feet above the crater; part of it fell back into the crater and part fell upon the slopes of the volcano. There was a light wind from the west during the eruption; no seismic disturbance accompanied the phenomenon and there was no damage to life or property. (Consular Service.)

Report received by the Navy Department from Commander J. M. Poyer, governor of American Samoa. (Belated dispatch, June 25, 1917.).

About 6:30 p. m., June 25, an earthquake and moderate tidal wave occurred here. Earthquakes are somewhat frequent here, but this was the severest one that has occurred, according to old residents. No one was injured. A few buildings on the island were injured, notably two churches—one in Leone and one in Pago Pago—which were so badly damaged that their further use is dangerous and has been forbidden. There was no damage at the naval station. The observatory at Apia broadcasted the following information by wireless: "The observer here places the center of the disturbance about 75 miles southwest of Samoa and considers it was due to a submarine landslide. No serious damage was done. Earthquake violent for about minute and a half, and minor shakes were experienced throughout the night at intervals. Tidal waves about 3 feet high were experienced on south coast of Savail, Upola, and Tutuila, causing minor damage, but no loss of life."

The rise and fall of the water in Pago Pago Bay exceeded that reported from Apia. The bay is much narrower at its head than at its mouth, with the result that at the head of the bay the water rose and fell between 5 and 6 feet above and below normal. Many of the natives were frightened and sought refuge in the mountains for the remainder of the night. (Assoc. Press.)

London, August 6, 1917.

A violent earthquake, which caused great damage, has occurred in the southern portion of *North Island, New Zealand*, according to a Reuter dispatch from Wellington. The Wairarapa district, northwest of Wellington, suffered most severely. Pioneer residents of North Island, the dispatch adds, describes the quake as the worst since the terrible upheaval 60 years ago. (Assoc. Press.)

Wellington, New Zealand, August 9, 1917.

Further severe earthquake shocks occurred at Wairarapa, northwest of Wellington. There were no casualties. (Assoc. Press.)

[1] Reported by the organizations indicated and collected by the seismological station at Georgetown University, Washington, D. C.

SECTION VI—BIBLIOGRAPHY.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

Aitken, John.
On some nuclei of cloudy condensation. Part 3. Edinburgh. 1917. 3 tables. 2 figures. 25½ cm. (Reprinted from the Proceedings of the Royal society of Edinburgh, session 1916–1917, v. 37, part 3 (No. 14), p. [215]–245.)

Angot Alfred.
Le canon et la pluie. (Photographed from France. Académie d'agriculture. Comptes rendus des séances, v. 3, 1917, no. 18, p. 501–508.) 24 cm.

Bartholomew, J[ohn] G[eorge].
Advanced atlas of physical and political geography: a new series of maps specially designed for schools, colleges and private students. Oxford. 1917. [1] [2] p. 96 col. maps, 31 p. 37½ cm. [Includes maps of temperature, rainfall, winds, clouds, and earthquakes for the world; maps of temperature and rainfall for each continent.]

Bigelow, Frank H[agar].
Author's abstract of the Meteorological treatise, atmospheric circulation and radiation; and the Astrophysical treatise, the sun's radiation and other solar phenomena. New York. 1917. iii, 36 p. diagrs. 23 cm.

Bouyoucos, George J. & McCool, M. M.
Freezing point method as a new means of measuring the concentration of the soil solution directly in the soil. East Lansing. 1915. 44 p. 2 figures. 12 tables. 23 cm. (Michigan. Agricultural college. Experiment station. Division of soils. Technical bulletin no. 24.)

Burnham, William H[enry].
The optimum temperature for mental work. (Reprinted from the Pedagogical seminary, March, 1917, v. 24, p. 53–71.) 23 cm. Bibliography, p. 70–71.

Chemulpo, Chosen, Meteorological observatory.
Results of the meteorological observations made at Chosen for the lustrum, 1911–15. Jinsen. 1917. [1] 27 p. [1] tables. 30½ cm. Final leaf in Japanese.

Cordeiro, F[rederick] J[oaquim] B[abosa].
Barometrical determination of heights, a practical method of barometrical levelling and hypsometry for surveyors and mountain climbers; 2d ed. rev. and enl. New York. 1917. 3 p. [1] 26 p. 16½ cm.

Covert, Roy N[orton].
Modern methods of protection against lightning. Washington. 1917. 32 p. 24 figures. illus. 23½ cm. (U. S. Department of agriculture. Farmers' bulletin 842. Contribution from the Weather bureau.)

Croydon natural history and scientific society.
Report of the meteorological committee, 1916, prepared by Francis Campbell-Bayard. Croydon. 1917. tables. 21½ cm. (Excerpted from Proceedings & transactions, v. 8, pt. 3, no. 12.)

Ferrara, Gerardo.
La neve; studio sintetico generale. Teramo. 1916. 94 p. [1] table. fold. chart. 24½ cm.

Gamba, Pericle.
Risultati dei lanci di palloni-sonda effettuati nel R. osserv. geofisico di Pavia nell'anno 1913. Milano. 1917. 3 tables. 24½ cm. (Estratto dei Rendiconti. Reale instituto Lombardo di scienze e lettere, v. 50, p. [604]–612.)

Sulla più grande altezza raggiunta da un pallone sonda e la distribuzione verticale della temperatura nell'atmosfera terrestra. Pavia. 1913. chart. tables. 24½ cm. (Estratto dei Rendiconti. Reale instituto Lombardo di scienze e lettere, v. 46, p. [505]–521.) Bibliography, p. 521.

Geneve. Observatoire.
Observations météorologiques faites aux fortifications de Saint-Maurice pendant l'année 1915. Résumé par Raoul Gautier et Ernest Rod. Genève. 1916. 56 p. (incl. title-page) tables. 22½ cm. (Extrait des Archives des Sciences physiques et naturelles, juillet et novembre 1915, janvier, mars et décembre 1916.)

Résumé météorologique de l'année 1915 pour Genève et le Grand Saint-Bernard par Raoul Gautier, directeur. Genève. 1916. 104 p. (incl. title-page) tables. 22½ cm. (Tiré des Archives des sciences de la Bibliothèque universelle, septembre et octobre 1916.)

Gladwin, F. E.
Winter injury of grapes. 8 plates. 10 tables. 22½ cm. (New York. Agricultural experiment station. Geneva, N.Y. Bulletin no. 433. April, 1917, p. 107–139.) Published by the Department of agriculture.

Great Britain. Meteorological office.
Charts showing the surface temperature of the Atlantic, Indian, and Pacific oceans. [Second ed. 1903] London. 1904. [2l] [16] charts, 49 x 37cm. Published by the authority of the Meteorological council. Official no. 59.

Hérault. [Commission météorologique.]
Bulletin météorologique. Année 1912 (40e année) Montpellier. 1916. 50 p. tables. charts. 27½cm.

Hongkong. Royal observatory.
Hongkong storm signal code. (Local.) Introduced on 1st July, 1917. Hongkong. 1917. 1 sheet. 32½ x 20cm.

Lamb, Edmund.
Climatological observations, taken at Borden Wood, in the Parish of Chithurst, County of Sussex, being the average for the years 1899–1908. [Liphook, Hants. Jan. 1909]. [4]p. tables. 26½ x 33cm.

Climatological observations, taken at Borden Wood, in the Parish of Chithurst, County of Sussex, during the year 1909–1916. [Liphook, Hants. Jan. 1910–Jan. 1917.] [4 p. ea. yr.] tables. 26½ x 33cm.

Ôsaka. Meteorological observatory.
Annual report for the year 1916. Part 1. Meteorological observations in Osaka, 1916. Osaka. 1917. cover-title, unp. 4 fold. charts. 25½cm.

Reed, William Gardner.
Coefficient of correlation. 3 tables. charts. 23 cm. (Reprinted from Quarterly publications of the American statistical association, June, 1917, p. 670–684.) Literature, p. 681–684.

Rijckevorsel, E[lie] van.
Konstant auftretende secundäre Maxima und Minima im dem jährlichen Verlauf der meteorologischen Erscheinungen. 11. Utrecht. 1917. cover-title, 76p. tables. figures (partly fold.) 25cm. At head of title: Sep. Abz. aus: Koninklijk nederlandsch meteorologisch instituut, no. 102. Mededeelingen en verhandelingen, 22.

Sweden. Hydrografiska byrån.
Årsberättelse för 1916. Stockholm. 1917. 49p. (incl. title-page) tables. illus. 31½cm.

Årsbok 6 för 1914. Stockholm. 1917. v. [1] 342 p. tables. 27 charts on 27 plates, 3 fold. maps, (one in pocket at back). 31½cm.

United provinces of Agra and Oudh. Department of land records and agriculture.
List of errata to the Monthly tables of rainfall ... from January to December, 1916. [Lucknow, 20th April, 1917.] 4 leaves. 33½cm.

Monthly and annual rainfall table ... for the year 1916. [Lucknow. 25th April, 1917]. 17 p. 33½cm.

Wallen, Axel.
Vattenstånds-förutsägelserna. Granskning af 1916 ars resultat och prognoser för ar 1917. Stockholm. 1917. 18 p. (incl. title-page) 4 tables. 5 charts (partly fold.) 20½cm. At head of title. Från hydrografiska byrån. (Särtryck ur Tecknisk tidskrift, Väg- och vattenbyggnadskonst, 1917, Häfte 3.)

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

Aeronautics. London. v. 13. Sept. 5, 1917.

Bollée, Léon. The soaring flight of birds. p. 187–191.

Franklin institute. Journal. v. 184. August, 1917.

Humphreys, W[illiam] J[ackson]. Physics of the air. p. 371–408.

Meteorological society of Japan. Journal. Tokyo. 36th year. July, 1917.

Okada, T. Some researches in the far eastern seasonal correlations. Fourth note. p. 65–78.

Nature. London. v. 99. *August 30, 1917.*

Easton, C. A forecast of coming winters. p. 524–525.

Scientific American. New York. v. 117. Sept. 22, 1917.

The value of dew. p. 211. [Plan for using dew to water plants.]

Scientific American supplement. New York. v. 84. Sept. 1, 1917.

Dines, W[illiam] H[enry]. Meteorology and aviation. p. 144. [Repr. from Nature; see this issue of the REVIEW, p. 401.]

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SECTION VII.—WEATHER AND DATA FOR THE MONTH.

THE WEATHER OF AUGUST, 1917.

P. C. DAY, Climatologist and Chief of Division.

[Dated: Weather Bureau, Washington, Oct. 1, 1917.]

PRESSURE AND WINDS.

The distribution of the mean atmospheric pressure over the United States and Canada, and the prevailing direction of the winds for August, 1917, are geographically shown on Chart VII (XLV—82), while the means at the several stations, with the departures from the normal, are shown in Tables I and III.

At the beginning of the month pressure was relatively high over the northern and central Rocky Mountain States and to the westward, and below the normal in the Lake region, but elsewhere it was generally near the seasonal average. During the first half of the month it was, as a rule, above the average over most districts, but about the middle relatively low pressure overspread most eastern districts. In a few days, however, there was a return to higher readings, which continued over most sections of the country for several days. Pressure during the latter portion of the month was below the average much of the time in the Northern States; in the more central and southern districts it was generally above normal, continuing so at the close in the eastern half of the country and in the far Northwest; elsewhere the pressure remained below the average.

For August as a whole the barometric pressure averaged above the normal over the entire country, except in portions of the Lake region, where it was slightly below the seasonal average. The departures from the normal were generally small, although somewhat pronounced in the far western districts.

The distribution of the HIGHS and LOWS resulted in frequent southerly winds from the Ohio Valley and the Lower Lakes eastward, and also over much of the Great Plains and Western Gulf States. Westerly winds prevailed in the district of the Upper Lakes and upper Mississippi Valley. Elsewhere variable winds prevailed.

TEMPERATURE.

August, 1917, opened with high temperatures in the Lake region, Ohio Valley, and the Middle and North Atlantic States, but with cool weather for the season over the northern plains. From about August 3 to 5 these conditions were reversed, warm weather appearing in the northern Plains States and lower temperatures in the more eastern districts. Temperatures below normal extended, about the 6th, over the South Atlantic and East Gulf States and into the Northwest; but from the 7th to 9th rather high temperatures occurred in parts of California, Nevada, New Mexico, and Texas, while cool weather obtained from Lake Michigan to the Missouri Valley. During the next several days low temperatures prevailed in most middle and northern interior districts and in the Southwest.

About the middle of the month rather high temperatures overspread the upper Missouri Valley and northern Plateau region; while on the 16th and 17th a moderately cool wave prevailed from the middle and upper Mississippi Valley and western Lakes Region and thence eastward. On the 20th and 21st hot weather obtained over most of the spring-wheat area and relatively cool weather in northern New England, the Lakes Region and upper Mississippi Valley. The high temperature in the spring-wheat area gave way about the 23d to cooler weather, which by the 25th overspread the middle and lower Mississippi Valley and reached the Eastern States on the 27th. During the same time higher temperature spread from the upper Mississippi Valley westward over the Northwest only to give way on the 27th to another cool wave. Frost or freezing temperatures were reported about August 28 from a few places in the Dakotas, northern Michigan and Wisconsin, and the weather was unseasonably cold over the northern and western parts of the great grain-growing area. This cool weather extended southward, and on the 29th at Amarillo, Tex., the minimum temperature was 49°, exceeding the lowest previous record for that place of August during the last 27 years. August closed with abnormally cool weather in the Northern States, but with moderate temperatures in most other districts.

For the month as a whole, the temperature was below the normal along the immediate Pacific coast, and from the Rocky Mountain region eastward, except in the Atlantic Coast States, and in New Mexico, Texas, Louisiana, and the southern half of Mississippi, where it was somewhat above the average (see Chart IV).

Over rather extensive areas in the upper Lakes Region and the Central Plains States the temperature for the month averaged 3 degrees or more below the normal.

PRECIPITATION.

During the first few days of August scattered showers and thunderstorms occurred in various parts of the country, but no widespread rainfall. From the 3d to 5th, much rain occurred in the South Atlantic and East Gulf States, and on the 6th and 7th rather extensive rains prevailed in the middle and western corn States. Notably heavy falls occurred at many stations in the eastern portions of Kansas and Nebraska and in western Iowa. From the 8th to the 11th heavy local precipitation occurred from Georgia to Maine, and also in portions of Oklahoma and the adjoining States. On the 12th light showers occurred in the upper Mississippi Valley and western Lakes Region. About the same time considerable rain fell in southern Colorado, the Texas Panhandle and Arkansas, and on the 15th and 16th widespread rains prevailed in Tennessee, Kentucky, and in districts from the eastern Gulf to southern Pennsylvania, as well as in southern and western Missouri, Kansas, northern Oklahoma, New Mexico, and western Texas. During the 18th to 21st, more or less rain occurred in much of Texas and in several of the southeastern States, and also in Nebraska and adjoining States, as well as in the western Lakes Region. From the 27th to 29th rain in irregular amounts fell from Utah to the Ohio Valley and Lakes Region, and moderate amounts occurred in portions of Texas and Louisiana and at places along the southern Atlantic coast.

The month closed with cloudy or rainy weather over most of the Atlantic and Gulf States, Tennessee, and Kentucky, and from the upper Lakes region westward to the Rocky Mountains. Elsewhere generally fair weather prevailed.

For the month as a whole precipitation was comparatively heavy in parts of the New England States, New York, Pennsylvania, Georgia, Florida, much of the east Gulf section, and likewise in portions of Kansas and Oklahoma. Elsewhere in the East moderate amounts fell, except in a few localities. Throughout the West the monthly totals were generally small, and no rain

fell over considerable areas in southern Texas, central and northern California, and in much of Oregon, Washington, and northern Idaho.

RELATIVE HUMIDITY.

The relative humidity for the month as a whole was above the normal in the northern and eastern portions of the Lakes Region and to the eastward, in the Ohio Valley, and from the central Mississippi Valley westward to the Pacific. Elsewhere the atmosphere was in most localities drier than the average for August, especially in the South Atlantic and west Gulf States and the upper Mississippi Valley and to the westward.

GENERAL SUMMARY.

The weather was favorable for outdoor work over the greater part of the country; harvesting, haying, and thrashing made good progress. On the other hand, except for about a week near the middle of the month, the weather was generally too cool for satisfactory development of crops in many central and northern districts. However, in the East and also in the Rocky Mountains and Great Plains States warmer weather and beneficial rains were favorable for the development of field and garden crops.

The unevenly distributed rain in the South resulted in rather poor progress of cotton in some sections, while in others it was good, and picking progressed rapidly. Corn developed satisfactorily, except that the unseasonably cool weather in some sections retarded its growth. The weather was favorable for potatoes and an excellent outlook was reported almost everywhere, although there was some injury by blight in a few sections. It was also favorable for fruit generally, except that the citrus variety was injured in Louisiana and Florida by dry weather and cranberries in Wisconsin suffered from the cold weather.

Average accumulated departures for August, 1917.

Districts.	Temperature.			Precipitation.			Cloudiness.		Relative humidity.	
	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure from the normal.	General mean for the current month.	Departure from the normal.
	°F.	°F.	°F.	In.	In.	In.	0-10		P. ct.	
New England	69.4	+2.3	−9.2	4.12	+0.30	−0.20	5.1	0.0	83	+2
Middle Atlantic	74.2	+1.4	−3.4	3.21	−1.20	−2.30	4.5	−0.6	75	−2
South Atlantic	78.2	+0.4	+5.6	4.08	−2.10	−6.70	5.0	−0.2	79	−3
Florida Peninsula	82.1	+0.2	+3.4	6.55	−0.40	−7.90	5.9	+0.5	76	−3
East Gulf	78.9	+0.3	+4.3	6.46	−1.60	−3.70	5.3	+0.2	80	0
West Gulf	81.7	+0.7	+3.4	2.26	−0.80	−8.70	3.6	−0.3	70	−5
Ohio Valley and Tennessee	74.0	−0.5	−11.1	3.11	−0.30	+2.40	4.8	+0.3	73	0
Lower Lakes	69.5	−0.1	−17.5	3.05	+0.10	+0.60	5.0	+0.4	72	0
Upper Lakes	64.1	−2.2	−23.5	2.00	−1.00	−2.20	5.1	+0.3	76	0
North Dakota	65.9	−0.8	−13.1	0.87	−1.40	−7.90	3.3	−0.9	60	−7
Upper Mississippi Valley	70.5	−2.4	−18.5	2.47	−0.80	−0.90	4.6	+0.3	70	−1
Missouri Valley	71.3	−2.5	−8.3	3.06	−0.20	−3.10	3.9	−0.3	67	0
Northern slope	65.1	−1.6	−18.5	0.78	−0.50	−1.30	3.8	−0.1	55	0
Middle slope	72.9	−2.3	−5.8	3.01	+0.60	−4.50	4.4	+0.5	65	+4
Southern slope	80.2	+1.1	+4.0	2.89	+0.70	−4.00	3.6	−0.2	59	−4
Southern Plateau	77.0	−0.3	−9.4	1.23	+0.10	−1.00	3.0	−0.6	54	+10
Middle Plateau	72.2	+0.6	−28.1	0.44	−0.30	−1.30	3.0	0.0	38	−1
Northern Plateau	72.2	+1.9	−18.0	0.01	−0.40	−1.40	2.0	−0.7	37	−5
North Pacific	63.0	+1.1	−11.0	0.29	−0.50	−5.50	3.3	−1.3	74	−2
Middle Pacific	65.2	+0.4	−7.5	0.00	0.00	−6.20	4.2	+0.9	62	0
South Pacific	70.8	+0.3	−0.7	T.	0.00	−2.30	2.6	0.0	67	+2

WEATHER CONDITIONS OVER THE NORTH ATLANTIC OCEAN DURING AUGUST, 1916.

The data furnished are for August, 1916. Comparisons and study of the same should be in connection with those appearing in the REVIEW for that month. Chart IX (XLV-84) shows for August, 1916, the average of pressure, temperature, and prevailing direction of the wind at 7 a. m., 75th meridian time (Greenwich mean noon), together with notes on the locations and courses of the more severe storms of the month.

PRESSURE.

The distribution of the average monthly pressure for August, 1916, as shown on Chart IX, was for the most part similar to the normal, especially south of the 40th parallel. The Azores or North Atlantic HIGH was slightly more extensive than usual, although practically normal in position and intensity. The Icelandic LOW with a minimum average of 29.7 inches, was central near latitude 57° N., longitude 28° W., which was considerably south of the position usually occupied by this area. The Continental HIGH was not well developed, although an isobar of 30 inches surrounded a large territory between the 20th and 45th parallels, extending as far westward as the 95th meridian. The lowest individual pressure reported during the month, was 28.88 inches and occurred on the 31st in the 5-degree square between latitude 55° to 60°, longitude 20° to 25°. The highest reading in the same square was 30.42 inches on the 4th. This latter reading was equal to the maximum recorded in the western part of the Azores HIGH, where the minimum was 29.7 inches and the average 30.09 inches.

The mean pressure for the three decades of the month differed considerably in some localities, as shown by the following table:

Pressures over the North Atlantic during August, 1916, by 5-degree squares.

Position of 5-degree square.		Decade means.			Extremes.			
					Highest.		Lowest.	
Latitude.	Longitude.	I	II	*III	Pressure.	Date.	Pressure.	Date.
°	°	Inches.	Inches.	Inches.	Inches.	August.	Inches.	August.
60-65 N	10-15 W	30.05	29.75	29.70	30.29	5	29.26	13
60-65 N	5-10 E	30.00	29.83	29.66	30.23	7	29.48	3,27
55-60 N	35-40 W	29.88	29.76	29.59	30.11	4	29.20	22
55-60 N	0- 5 E	30.17	29.78	29.69	30.29	7	29.42	26
50-55 N	45-50 W	29.82	29.78	29.80	30.21	5	29.40	13,14
50-55 N	20-25 W	30.10	29.78	29.54	30.42	4	29.14	24
50-55 N	10-15 W	30.25	29.79	29.64	30.43	3	29.37	25
45-50 N	65-70 W	29.98	29.91	29.88	30.30	10	29.46	14
45-50 N	25-30 W	29.91	30.02	29.65	30.32	3	29.09	21
40-45 N	35-40 W	30.01	30.14	29.94	30.40	4,17	29.38	9
35-40 N	75-80 W	30.04	30.03	30.01	30.20	29	29.80	24
35-40 N	50-55 W	30.04	30.10	30.07	30.40	4,5	29.70	24
35-40 N	10-15 W	30.13	30.11	30.01	30.22	7,18	29.88	28
25-30 N	90-95 W	29.98	30.02	29.96	30.21	12	29.88	25
25-30 N	55-60 W	30.15	30.13	30.10	30.28	11	30.00	14
25-30 N	35-40 W	30.21	30.15	30.08	30.30	5,11	29.97	21
15-20 N	80-85 W	29.94	29.90	29.86	30.01	11,12	29.70	16
15-20 N	25-30 W	30.06	29.97	29.97	30.10	3	29.88	21

*Includes the last 11 days of the month.

The mean and extreme pressures presented in the above table are based on the daily pressure values determined by interpolation for each square from the MS daily synoptic charts of the North Atlantic compiled by the Marine Section of the Weather Bureau.

GALES.

The number of days on which gales were reported along the steamer lanes during August, 1916, was considerably above the normal, and in some cases the increase was marked. The greatest number occurred in the 5-degree square between latitudes 45°–50°, longitudes 30°–35°, where they were encountered on 7 days, a percentage of 23, while the normal percentage for that square is only 5. They were comparatively rare along the American and European coasts, the number being somewhat less than usual.

On August 2 a well developed LOW was central about 120 miles northeast of St. Johns, Newfoundland, where the barometer reading was 29.36 inches. A number of reports were received from vessels between the 41st and 46th parallels and the 42d and 60th meridians, that indicated southerly gales of from 40 to 56 miles an hour in the eastern portion of the storm area, while northeasterly gales of slightly less velocity prevailed over the western part. This LOW evidently moved toward the north, as on the 3d only the southern quadrants appeared on the chart, while a few vessels in widely scattered localities reported winds of gale force. From the 5th to the 7th an area of low pressure covered a limited area along the North American coast; this was of comparatively slight intensity, with moderate and light winds prevailing over practically the entire ocean. On Chart III "Tracks of Low Areas" (XLIV–87) in the MONTHLY WEATHER REVIEW for August, 1916, is shown a LOW (*I* on Chart IX) that first appeared on the map about 130 miles west of Valentine, Nebr., on the evening of the 5th. This disturbance moved toward the east with a fairly uniform rate of translation, and on the 8th its center was near Eastport, Me., where the barometer read 29.56 inches. On the same day another LOW was central about 8° east of St. Johns, Newfoundland, the lowest barometer reading being 29.33 inches. These two areas evidently merged and on the 9th the center of the disturbance was near latitude 46°, longitude 42. On both the 8th and 9th, only light to moderate winds were reported, while fog covered a limited area in the vicinity of the American coast. The path of LOW *I* then curved toward the northeast and on the 10th the center was near latitude 50°, longitude 32°; the storm had increased in intensity since the previous day, as a number of vessels experienced gales of from 40 to 50 miles an hour. The LOW continued in its northeasterly course until the 12th, when it was central near latitude 59°, longitude 22°, the lowest pressure reading on both the 11th and 12th being 29 inches, and the condition of wind and weather remaining about the same as on the 10th. The disturbance then curved toward the east, moving slowly, and on the 13th was near latitude 60°, longitude 18°. It had decreased somewhat in intensity, for the wind had moderated since the 12th. LOW *I* then curved slightly toward the southeast, and on the 15th the area of low pressure covered Scotland and northern England, the wind velocity on the 14th and 15th being about the same as on the 13th.

A storm of the West Indies hurricane type was described for August, 1916, by Mr. R. H. Weightman in the MONTHLY WEATHER REVIEW for December, 1916 (44: 686–688, with Chart X). The disturbance first appeared some distance east of Barbados on August 12, but was too far south to appear on our Chart IX until the 15th. It is shown as LOW *II*, with its center between Haiti and Jamaica. The lowest barometer reading was 29.64 inches, and one vessel near the center of its limited area reported a northeasterly gale of about 50 miles an hour. The highest wind during this storm, reported by any vessel was 55 miles an hour, on the 16th, near latitude 19° N., longitude 82° W.

From the 21st to the 23d a well-developed LOW was central near the 50th parallel and between the 25th and 35th meridians. During these three days the barometric reading at the storms center remained nearly constant at about 29 inches; and westerly gales of from 40 to 55 miles an hour prevailed over the southern quadrants. Between the 23d and 24th this disturbance seems to have moved toward the northeast, as on the latter date the center was near latitude 55°, longitude 25°, where a barometric reading of 28.84 inches was recorded. This fall in pressure apparently was attended by no increase in the wind velocities, which were even slightly lower than on the day before. This LOW then moved a short distance toward the north, increasing in extent and decreasing in intensity, and on the 25th it covered a large area between the 52d and 61st parallels, and the 13th and 33d meridians. On the same date LOWS of slight intensity existed off the coast of Canada and in the Caribbean Sea, respectively, light winds prevailing in both localities, with fog along the Canadian and New England coasts. From the 26th to the 29th the general weather conditions were comparatively featureless, with light winds over the entire ocean, and fog off the Banks of Newfoundland.

On the 30th a LOW, with a minimum reading of 28.89 inches, was central near latitude 56°, longitude 29°, while a number of vessels in the vicinity reported moderate gales. On the same date a second LOW of slight intensity covered a limited area immediately south of Cuba, while a third of much the same character was central about 3° east of Cape Henry. The first, or northern LOW, moved slowly toward the east during the next 24 hours, and on the 31st the center was near latitude 58°, longitude 18°. The barometer fell to 28.84 inches and a few vessels in the western quadrants encountered northwesterly gales of from 50 to 60 miles an hour. The second LOW of August 30 remained practically stationary in position and intensity, while there was no sign of the third on the 31st.

TEMPERATURE.

The mean monthly temperature of the air over the ocean was somewhat above the normal north of the 40th parallel and east of the 60th meridian, while over the waters adjacent to the American coast, and in the Gulf of Mexico, the departures were small, ranging from +1 to −1 degree. The departures at a number of Canadian and United States Weather Bureau stations on the Atlantic and Gulf coasts were as follows:

	°F.		°F.
St. John's, N. F.	−0.6	Norfolk, Va.	+0.2
Sidney, C. B. I.	+2.0	Hatteras, N. C.	−0.4
Halifax, N. S.	+1.9	Charleston, S. C.	+1.5
Eastport, Me.	+0.5	Key West, Fla.	−1.3
Portland, Me.	+0.2	Tampa, Fla.	+1.7
Boston, Mass.	+2.9	Mobile, Ala.	+2.3
Nantucket, Mass.	−0.7	New Orleans, La.	+2.4
Block Island, R. I.	+0.1	Galveston, Tex.	+0.4
New York, N. Y.	+1.4	Corpus Cristi, Tex.	+0.5

The lowest temperature reported during the month was 48°F. and occurred on the 5th and 6th over the waters adjacent to the coast of Labrador, while the high-

est for the same region was 58°, observed on a number of different days.

FOG.

Off the Banks of Newfoundland the number of days on which fog was observed was somewhat below the normal, while in the vicinity of Nantucket Shoals it was reported on 13 days, a percentage of 42, while the normal of that region is from 30 to 35 per cent. Over the central portion of the steamer routes the amount was about the same as usual, while off the coasts of Ireland and Scotland it was considerably above the normal.

Winds of 50 mis./hr. (22.4 m./sec.) or over during August, 1917.

Station.	Date.	Velocity.	Direction.	Station.	Date.	Velocity.	Direction.
		Mis./hr.				Mis./hr.	
Bismarck, N.Dak.	22	50	nw.	New York, N. Y...	24	52	s.
Duluth, Minn....	23	56	nw.	Oklahoma, Okla...	8	50	n.
Eastport, Me.....	10	54	ne.	Point Reyes Light,			
El Paso, Tex.....	29	53	nw.	Cal.....	19	51	nw.
Grand Junction,				Do.....	20	54	nw.
Colo.....	10	54	nw.	Sandusky, Ohio..	16	54	n.
Kansas City, Mo...	8	62	nw.	Sandy Hook, N. J.	1	73	s.
Lincoln, Nebr....	4	60	nw.	Do.....	2	56	s.
Marquette, Mich..	4	55	se.	Do.....	24	64	sw.
Mount Tamalpais,							
Cal.....	5	60	nw.				

CONDENSED CLIMATOLOGICAL SUMMARY.

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, August, 1917.

Section.	Temperature.							Precipitation.					
	Section average.	Departure from the normal.	Monthly extremes.					Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest. Date.			Station.	Amount.	Station.	Amount.
	°F.	°F.		°F.			°F.	In.	In.		In.		In.
Alabama	78.1	−1.5	Decatur	101	1	Oneonta	46 26	6.17	+1.90	Alaga	15.55	Madison	1.29
Arizona	77.3	−0.4	Aztec	119	24	Morman Lake R. S.	31 20	1.43	−0.67	Bisbee	6.20	Redrock	0.00
Arkansas	77.1	−2.1	Bee Branch	104	16	Dutton	43 25	4.10	+0.59	Warren	7.50	Marked Tree	0.90
California	72.5	−0.3	Greenland Ranch	123	1†	Barrett Dam	30 21†	0.04	−0.04	McCloud	1.53	102 stations	0.00
Colorado	62.9	−2.3	Two Buttes	104	4	Fraser	24 29	1.73	−0.21	Fairplay	6.13	Denver	0.05
Florida	81.2	−0.1	5 stations	99	1†	2 stations	58 26	7.72	+0.44	Pinellas Park	20.06	Fort Pierce	3.18
Georgia	78.5	−0.8	4 stations	100	1†	Ramhurst	46 26	5.50	+0.06	Fort Gaines	11.49	Millen	1.24
Hawaii (for July)	74.2	−0.2	Mahukona	96	17	Volcaus Ob., Hawaii	49 12	3.05	−2.09	Wahiawa M'nt'n	15.40	7 stations	0.00
Idaho	67.4	+0.4	Weiser	108	2	New Meadows	20 1	0.19	−0.64	Rice	1.30	17 stations	0.00
Illinois	71.8	−2.2	Montrose	101	1	2 stations	39 25	2.66	−0.69	Morrisonville	7.59	Antioch	0.17
Indiana	71.9	−1.3	Rome	100	5	Salem	37 28	2.60	−0.72	Monticello	5.46	Anderson	1.10
Iowa	69.4	−2.4	Lenox	102	4	Matlock	31 28	2.29	−1.39	Onawa	6.31	Davenport	0.70
Kansas	73.4	−3.6	Phillipsburg	109	4	2 stations	40 28†	4.94	+1.90	Macksville	10.20	Leoti	1.58
Kentucky	73.9	−1.8	2 stations	100	1†	2 stations	42 26†	3.49	+0.14	Pikeville	8.80	London	0.98
Louisiana	81.1	−0.6	Angola	108	9	2 stations	53 26	5.71	+0.81	Paradis	12.17	Logansport	1.71
Maryland-Delaware	73.5	+0.1	2 stations	100	1	Oakland, Md	40 27	3.19	−1.49	Emmitsburg, Md.	6.31	Washington, D. C.	0.77
Michigan	64.9	−1.8	Midland	103	1	2 stations	25 30	2.38	−0.32	Wasepi	5.67	Bloomingdale	0.34
Minnesota	64.9	−1.9	2 stations	100	17	Meadowlands	26 29	2.10	−1.35	Winton	6.57	Detroit	0.40
Mississippi	79.2	−1.3	Auguilla	102	16	Tupelo	49 26	4.72	+0.37	Magnolia	9.87	Crenshaw	1.05
Missouri	73.3	−2.9	Caruthersville (2)	104	1†	Steffenville	38 10	4.45	+0.94	Jackson	11.46	Palmyra	0.98
Montana	64.0	0.0	Springbrook	110	17	2 stations	19 1†	0.48	−0.66	Adel	1.96	3 stations	0.00
Nebraska	69.6	−3.1	Geneva	108	4	Gordon	32 24	2.34	−0.48	Wisner	9.10	Arcadia	0.27
Nevada	70.6	0.0	Las Vegas	108	7	Gold Creek	32 15	0.35	−0.10	Searchlight	2.49	6 stations	0.00
New England	69.5	+2.6	Waterbury, Conn	102	1	Chelsea, Vt	29 27	5.00	+1.05	Blue Hill, Mass	8.58	Block Island, R. I.	0.73
New Jersey	74.0	+1.9	Elizabeth	103	1	Culvers Lake	41 26	2.21	−2.75	Long Branch	5.68	Paterson	0.86
New Mexico	70.3	−0.4	Artesia	107	11	2 stations	30 27†	2.53	−0.34	Mayhill Ranger Sta.	8.12	Fruitland	T.
New York	69.2	+1.7	Farmingdale	101	1	Gabriels	37 31	3.79	+0.11	Newark Valley	8.59	Mount Vernon	1.17
North Carolina	74.8	−0.7	3 stations	100	1	Banners Elk	40 26	3.60	−2.40	Statesville	7.71	Enfield	1.15
North Dakota	65.3	−0.3	Marstonmoor	105	18	Marstonmoor	25 29	0.83	−1.46	Lisbon	3.40	Buford	T.
Ohio	71.3	−0.3	Danbury	101	1	Peebles	38 26	2.70	−0.36	Demos	6.86	Ironton	1.01
Oklahoma	78.1	−3.1	2 stations	107	1	2 stations	44 29	5.80	+2.99	Alva	11.10	Eldorado	0.74
Oregon	68.4	+2.7	Echo	106	16	Crescent	21 10	0.08	−0.42	Vistillas	0.76	50 stations	0.00
Pennsylvania	71.2	+1.2	Carlisle	101	2	Brookville	38 26	6.69	+0.70	Bloserville	17.50	Milford	1.06
Porto Rico	78.6	−0.5	2 stations	96	8†	Aibonito	58 23	6.75	−1.14	Anasco	18.85	Destino	1.97
South Carolina	78.5	−0.3	Calhoun Falls	102	1	Mountain Rest	49 25	3.23	−2.93	Conway	8.62	Darlington	0.70
South Dakota	67.9	−2.0	Kadoka	108	3	Pollock	31 9	1.49	−1.21	La Delle	3.77	Belle Fourche	0.40
Tennessee	74.6	−1.9	London	99	6	2 stations	39 26	4.06	−0.13	Carthage	7.76	Bolivar	1.18
Texas	83.9	+1.1	Jourdanton	113	22	Lieb (near)	43 29	1.73	−0.53	Jefferson	8.14	6 stations	0.00
Utah	68.9	−0.6	St. George	108	2	Snowville	30 29	0.51	−5.20	Monticello	2.01	10 stations	0.00
Virginia	73.4	−0.6	Dimond Springs	103	1	2 stations	35 26	2.90	−1.60	Charlottesville	8.11	Radford	0.36
Washington	67.4	+2.1	3 stations	105	16	Castle Rock	30 10	0.13	−0.62	Queets River	1.51	55 stations	0.00
West Virginia	71.6	−0.1	2 stations	102	1†	4 stations	39 26	3.53	+0.02	Moundsville	8.80	Clay	0.94
Wisconsin	64.5	−2.2	Stevens Point (2)	98	1†	Big St. GermainDam	27 30	2.73	−0.80	Marshfield	8.41	New Richmond	0.57
Wyoming	60.2	−2.8	2 stations	101	3†	2 stations	22 11†	0.83	−0.34	Sand Lake	2.31	Hyattville	0.00

† Other dates also.

DESCRIPTION OF TABLES AND CHARTS.

(See MONTHLY WEATHER REVIEW, July, 1917, p. 388.)

TABLE I.—*Climatological data for Weather Bureau stations, August, 1917.*

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.												Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.						Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.						Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.							
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F*		°*F*	°*F.*		°*F*	°*F.*	°*F.*	°*F.*	%	*In.*	*In.*		*Miles.*									*0–10*	*In.*	*In.*
New England.							**69.4**	**+2.3**										**83**	**4.12**	**+0.3**											**5.1**		
Eastport	76	67	85	29.95	30.03	+0.07	60.2	+0.5	79	7	68	48	16	53	24	58	57	92	4.44	+1.2	15	5,291	s.	54	ne.	10	9	8	14	6.2	.....	.....
Greenville	1,070	6	.....	28.88	30.03	.....	64.7	.....	90	2	74	44	27	56	31	.....	.....	.....	4.98	.....	19	.....	.....	.....	.....	.....	10	7	14	.....	.....	.....	.....	.....
Portland, Me.	103	82	117	29.91	30.03	+ .03	66.9	+0.7	85	2	74	52	27	60	24	63	60	82	4.78	+1.2	11	5,373	s.	22	s.	1	10	9	12	5.6	.....	.....
Concord	288	70	79	.....	30.04	+ .06	70.0	+3.4	99	1	81	45	27	60	35	.....	.....	.....	4.72	+1.0	12	3,006	se.	25	n.	2	13	8	10	.....	.....	.....
Burlington	404	11	48	29.56	29.98	+ .01	68.4	+2.3	98	1	77	47	31	60	31	.....	.....	.....	3.52	−0.5	16	6,441	s.	34	s.	1	8	11	12	5.9	.....	.....
Northfield	876	12	60	29.09	30.02	+ .04	65.1	+2.2	95	1	76	43	31	54	36	61	59	86	3.11	−0.8	14	4,112	s.	28	s.	8	4	10	17	7.1	.....	.....
Boston	125	115	188	29.89	30.02	+ .03	72.8	+3.9	98	1	81	58	26	65	26	66	63	77	7.06	+3.0	10	6,014	sw.	27	nw.	2	15	11	5	4.0	.....	.....
Nantucket	12	14	90	30.02	30.03	+ .04	69.2	+1.2	82	13	76	55	16	63	20	65	64	90	1.56	−1.5	10	9,234	sw.	44	n.	10	18	7	6	4.5	.....	.....
Block Island	26	11	46	30.00	30.03	+ .01	70.6	+1.9	85	1	77	59	26	64	19	68	67	91	0.73	−2.8	5	8,992	sw.	40	nw.	10	15	7	9	4.3	.....	.....
Naragansett Pier	.....	9	.....	.....	.....	.....	70.0	+1.5	84	2	77	54	26	63	22	.....	.....	.....	3.64	.....	10	.....	s.	.....	.....	.....	19	9	3	.....	.....	.....	.....	.....
Providence	160	215	251	29.85	30.02	+ .03	72.8	+1.8	97	2	81	56	28	64	26	66	63	78	5.90	+1.8	11	7,489	sw.	34	ne.	21	10	15	6	4.9	.....	.....
Hartford	159	122	140	29.84	30.01	+ .02	73.3	+4.4	100	1	82	56	26	64	28	66	63	75	6.92	+2.4	10	4,928	s.	30	sw.	2	15	12	4	4.1	.....	.....
New Haven	106	117	155	29.91	30.02	+ .03	73.5	+3.4	94	1	82	55	26	65	25	66	63	75	2.53	−2.5	9	6,014	s.	26	nw.	17	16	9	6	4.1	.....	.....
Middle Atlantic States.							**74.2**	**+1.4**										**75**	**3.21**	**−1.2**											**4.5**		
Albany	97	102	115	29.90	30.00	+0.02	72.8	+3.3	98	1	82	53	31	63	30	65	61	73	2.70	−1.3	10	4,841	s.	24	s.	15	14	12	5	4.4	.....	.....
Binghamton	871	10	69	29.09	30.00	+ .01	70.5	+3.0	92	2	80	49	26	60	33	.....	.....	.....	7.50	+4.2	15	2,816	e.	25	nw.	6	5	18	8	5.8	.....	.....
New York	314	414	454	29.68	30.01	+ .01	74.6	+2.4	98	1	82	56	26	67	24	67	63	74	1.79	−2.7	9	9,737	s.	52	s.	24	9	13	9	5.2	.....	.....
Harrisburg	374	94	104	29.63	30.02	+ .01	73.8	+1.7	96	2	83	53	26	65	28	65	62	72	6.39	+2.1	10	3,674	s.	34	nw.	2	10	14	7	4.8	.....	.....
Philadelphia	117	123	190	29.90	30.02	+ .02	76.7	+2.9	96	2	85	58	26	66	22	67	63	69	3.82	−0.8	8	6,462	sw.	31	sw.	29	13	10	8	4.9	.....	.....
Reading	325	81	98	29.69	30.03	.....	74.8	.....	96	2	84	53	26	65	29	66	63	73	3.00	−1.5	9	4,102	s.	30	nw.	2	14	9	8	4.4	.....	.....
Scranton	895	111	119	29.18	30.03	+ .03	71.5	+2.2	95	2	82	50	26	61	31	65	62	78	3.94	−0.3	11	4,057	sw.	42	w.	2	6	15	10	6.0	.....	.....
Atlantic City	52	37	48	29.97	30.02	+ .02	74.5	+1.9	92	1	80	55	26	69	21	70	67	78	2.44	−1.9	6	4,878	s.	18	sw.	24	13	13	5	3.8	.....	.....
Cape May	18	13	49	30.03	30.05	+ .05	74.2	+0.8	91	1	81	56	26	68	20	70	.....	.....	1.41	−2.8	7	4,839	s.	26	nw.	2	19	9	3	3.3	.....	.....
Sandy Hook	22	10	57	29.99	30.01	.....	74.4	.....	94	2	81	59	26	68	21	69	66	80	2.77	.....	9	9,019	s.	73	s.	1	12	12	7	4.1	.....	.....
Trenton	190	159	183	29.81	30.01	.....	74.8	.....	95	1	84	53	26	66	25	67	64	75	2.11	−3.3	8	6,778	s.	44	nw.	16	14	8	9	4.9	.....	.....
Baltimore	123	100	113	29.89	30.02	+ .01	76.4	+1.7	98	2	84	57	26	68	24	68	64	71	2.39	−1.8	9	4,433	s.	24	s.	29	15	9	7	4.1	.....	.....
Washington	112	62	85	29.90	30.01	.00	75.9	+1.4	96	2	85	54	26	66	30	68	65	75	0.77	−3.6	6	3,556	s.	20	nw.	9	15	10	6	4.0	.....	.....
Lynchburg	681	153	188	29.30	30.03	+ .01	75.4	+0.6	97	1	86	50	27	64	35	67	63	74	3.53	−0.7	11	3,402	n.	29	nw.	30	17	11	3	3.7	.....	.....
Norfolk	91	170	205	29.93	30.03	+ .03	77.8	+1.1	98	1	85	64	27	70	21	70	67	76	4.54	−1.4	10	6,703	se.	36	se.	24	14	11	6	4.2	.....	.....
Richmond	144	11	52	29.88	30.03	+ .02	75.8	−1.7	95	2	85	56	27	66	29	69	66	79	2.74	−1.7	9	4,069	se.	29	nw.	30	14	9	8	4.6	.....	.....
Wytheville	2,293	49	55	27.72	30.02	+ .01	69.4	−1.1	91	1	81	45	26	58	35	62	60	78	2.34	−2.2	9	2,736	w.	19	w.	25	12	14	5	4.2	.....	.....
South Atlantic States.							**78.2**	**+0.4**										**79**	**4.08**	**−2.1**											**5.0**		
Ashville	2,255	70	84	27.76	30.05	+0.03	70.3	−0.2	88	2	80	49	26	61	28	63	61	80	4.58	−0.2	9	4,570	se.	26	se.	31	10	14	7	5.0	.....	.....
Charlotte	773	153	161	29.20	30.02	.00	76.8	+0.2	95	1	86	61	26	68	26	68	64	72	4.81	−0.7	8	5,833	ne.	35	nw.	2	9	9	13	5.7	.....	.....
Hatteras	11	12	50	30.00	30.01	.00	78.8	+0.6	89	3	84	69	7	74	16	74	72	82	2.48	−3.4	10	7,654	ne.	34	nw.	3	15	14	2	4.1	.....	.....
Manteo	12	5	43	.....	.....	.....	75.4	.....	99	1	84	56	20	66	0	.....	.....	.....	2.66	−3.3	6	.....	ne.	.....	.....	.....	23	4	4	.....	.....	.....	.....	.....
Raleigh	376	103	110	.....	30.01	.00	76.9	+0.1	95	1	86	59	27	68	27	.....	.....	.....	1.30	−4.6	8	4,131	ne.	27	nw.	2	7	17	7	.....	.....	.....
Wilmington	78	81	91	29.94	30.02	+ .02	78.4	+0.8	92	1	86	63	27	71	22	72	70	82	2.28	−4.2	7	4,353	ne.	20	e.	21	11	13	4	4.4	.....	.....
Charleston	48	11	92	29.96	30.01	.00	80.2	−0.1	94	10	86	70	25	74	19	74	72	79	5.06	−1.9	11	6,254	ne.	28	e.	12	11	11	9	4.6	.....	.....
Columbia, S. C.	351	41	57	29.65	30.02	+ .01	79.0	−0.5	98	2	88	65	28	70	23	70	67	74	1.52	−5.3	7	3,951	ne.	23	sw.	8	12	9	10	5.0	.....	.....
Augusta	180	62	77	29.81	30.00	− .01	80.2	+1.3	97	1	89	64	25	71	26	73	70	78	1.86	−3.7	7	3,422	se.	23	nw.	16	11	12	8	4.9	.....	.....
Savannah	65	150	194	29.94	30.01	.00	80.2	+0.8	93	2	88	70	3	72	21	74	72	83	10.22	+2.7	15	5,087	w.	21	e.	27	8	12	11	6.0	.....	.....
Jacksonville	43	200	245	29.97	30.02	+ 0.1	81.2	+1.1	93	1	88	69	4	74	18	74	73	83	6.65	+0.4	16	7,091	sw.	42	sw.	1	5	19	7	5.6	.....	.....
Florida Peninsula.							**82.1**	**+0.2**										**76**	**6.55**	**−0.4**											**5.9**		
Key West	22	10	64	29.98	30.00	+0.02	83.6	−0.2	92	17	89	72	26	78	15	76	73	72	4.79	+0.1	12	6,242	se.	39	sw.	23	8	15	8	5.5	.....	.....
Miami	25	71	79	30.01	30.04	.....	81.3	−0.7	89	20	87	71	31	76	18	75	72	75	4.32	−3.3	14	5,250	se.	25	sw.	20	7	10	14	6.3	.....	.....
Sand Key	23	39	72	29.97	29.99	+ .01	82.0	.....	90	9	85	71	23	79	17	76	73	74	2.83	.....	14	8,040	se.	44	nw.	23	9	17	5	5.0	.....	.....
Tampa	35	79	92	29.98	30.01	+ .01	81.4	+1.4	94	8	88	70	11	74	20	75	73	81	10.54	+2.0	20	3,874	se.	29	se.	28	3	16	12	6.9	.....	.....
East Gulf States.							**78.9**	**−0.3**										**80**	**6.46**	**−1.6**											**5.3**		
Atlanta	1,174	190	216	28.82	30.03	+0.02	75.4	−0.7	92	1	83	59	26	67	24	68	65	76	5.61	+1.1	15	6,241	nw.	42	nw.	23	11	7	13	5.6	.....	.....
Macon	370	78	87	29.64	30.03	+ .02	78.5	+0.3	95	1	88	59	26	69	27	71	68	78	5.12	+0.9	14	3,376	e.	38	nw.	8	10	10	11	5.5	.....	.....
Thomasville	273	49	58	29.71	30.03	.00	80.4	−0.6	95	1	89	65	26	71	25	72	71	82	8.95	+3.9	14	2,296	ne.	24	sw.	3	3	21	7	6.2	.....	.....
Pensacola	56	149	185	29.94	30.00	+ .02	79.6	−1.4	90	10	86	69	26	73	18	74	72	81	9.47	+2.3	15	6,811	w.	44	ne.	16	5	16	10	5.8	.....	.....
Anniston	741	9	57	29.25	30.03	.00	75.4	−1.0	93	1	86	50	26	65	34	.....	.....	.....	11.17	+6.7	13	2,956	se.	28	n.	15	14	14	3	3.8	.....	.....
Birmingham	700	11	48	29.28	30.04	+ .05	77.8	−2.0	94	1	87	56	26	68	29	70	67	80	8.98	+4.5	14	3,453	ne.	22	s.	1	7	15	9	5.1	.....	.....
Mobile	57	125	161	29.94	30.00	+ .02	81.0	+1.3	95	16	90	66	26	72	25	74	72	82	6.42	−0.4	17	5,044	nw.	40	n.	16	8	15	8	5.4	.....	.....
Montgomery	223	100	112	29.76	30.01	+ .02	79.2	−0.5	94	1	88	62	27	70	28	72	69	79	3.04	−1.2	16	3,455	ne.	25	n.	16	10	11	10	5.4	.....	.....
Corinth	469	6	.....	.....	.....	.....	77.3	.....	94	18	89	50	26	65	39	.....	.....	.....	1.78	.....	7	.....	s.	.....	.....	.....	11	19	1	.....	.....	.....	.....	.....
Jackson	304	5	.....	.....	.....	.....	81.1	.....	100	15	93	58	25	69	33	.....	.....	.....	4.17	.....	11	.....	sw.	.....	.....	.....	10	16	5	.....	.....	.....	.....	.....
Meridian	375	85	93	29.61	30.00	+ .02	78.6	+0.1	94	15	88	55	27	69	33	70	68	78	1.77	−1.8	12	2,813	ne.	26	n.	22	8	14	9	5.1	.....	.....
Vicksburg	247	65	74	29.74	30.02	+ .04	79.6	0.0	94	16	88	65	26	71	25	72	70	79	3.65	+0.1	9	3,544	sw.	41	se.	16	14	10	7	4.3	.....	.....
New Orleans	51	76	84	29.94	29.99	+ .01	82.6	+1.6	95	9	90	72	17	75	22	75	73	80	6.92	+1.3	19	3,682	w.	33	ne.	17	4	19	8	5.8	.....	.....
West Gulf States.							**81.7**	**+0.7**										**70**	**2.26**	**−0.8**											**3.6**		
Shreveport	249	77	93	29.73	29.99	+0.02	80.6	−0.8	95	16	89	66	25	72	22	73	70	74	5.55	+3.3	7	3,735	e.	28	n.	10	22	4	5	3.4	.....	.....
Bentonville	1,303	11	44	28.67	30.01	+ .04	73.2	−3.3	94	1	84	51	30	63	32	.....	.....	.....	3.32	−0.7	11	2,896	se.	28	s.	8	16	8	7	3.9	.....	.....
Fort Smith	457	79	94	29.51	29.98	+ .01	78.6	−0.8	100	1	88	60	25	69	29	69	66	72	3.18	−0.5	13	4,533	e.	37	w.	1	13	7	11	4.9	.....	.....
Little Rock	357	139	147	29.63	30.00	+ .02	77.7	−1.5	95	1	86	60	30	69	24	70	67	75	4.38	+0.7	8	4,456	e.	42	nw.	7	14	8	9	4.6	.....	.....
Brownsville	57	4	26	.....	.....	.....	85.4	.....	102	23	96	72	26	75	23	.....	.....	.....	0.29	.....	1	.....	se.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corpus Christi	20	69	77	29.96	29.98	+ .05	82.8	+0.7	94	23	88	72	30	77	17	77	75	83	0.41	−1.9	1	10,572	se.	33	se.	20	18	12	1	3.4	.....	.....
Dallas	512	109	117	29.44	29.97	.....	84.1	.....	101	16	94	60	30	74	26	.....	.....	.....	2.67	.....	5	5,590	s.	33	nw.	19	11	15	5	4.6	.....	.....
Fort Worth	670	106	114	29.25	29.95	+ .01	84.2	+1.3	102	22	95	61	30	74	28	70	64	58	1.92	0.0	3	6,433	se.	33	se.	28	15	14	2	3.6	.....	.....
Galveston	54	106	114	29.94	30.00	+ .04	83.5	+0.9	92	24	88	70	29	79	15	76	73	74	2.71	−2.3	7	7,417	s.	24	n.	23	20	6	5	3.3	.....	.....
Houston	138	111	121	29.85	29.99	.....	85.0	+2.1	102	23	95	68	30	75	26	.....	.....	.....	1.13	.....	4	5,039	s.	33	se.	28	21	9	1	2.8	.....	.....
Palestine	510	64	72	29.45	29.96	− .01	83.0	+2.5	101	22	94	62	25	73	32	71	67	67	0.07	−2.2	1	4,336	ne.	24	w.	22	17	9	5	4.0	.....	.....
Port Arthur, Tex	34	58	66	29.94	29.98	.....	84.4	.....	95	10	90	66	25	75	23	77	75	86	6.79	.....	11	5,489	sw.	36	ne.	18	13	13	5	3.8	.....	.....
San Antonio	.....	.....	.....	.....	.....	+ .01	85.6	+3.6	104	23	97	69	30	74	27	71	64	58	0.10	−2.6	1	5,425	s.	43	nw.	23	28	3	0	1.3	.....	.....
Taylor	552	55	63	29.40	30.00	+ .05	84.8	+3.1	105	22	97	62	30	73	32	.....	.....	.....	1.00	−1.5	6	6,307	s.	33	ne.	22	16	15	0	3.3	.....	.....

TABLE I.—*Climatological data for Weather Bureau stations, August, 1917*—Continued.

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.												Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.						Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.						Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.							
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F*		°*F*	°*F.*		°*F*	°*F.*		°*F.*	°*F.*			%	*In.*	*In.*		*Miles.*									*0–10*	*In.*	*In.*
Ohio Valley and Tennessee.							**74.0**	**−0.5**													**73**	**3.11**	**−0.3**											**4.8**		
Chattanooga	762	189	213	29.24	30.03	+0.03	75.3	−1.2	91	1	84	57	26	67	26		63	65			77	5.71	+2.0	12	4,198	ne.	37	n.	2	8	12	11	5.5	.....	.....
Knoxville	996	102	111	28.99	30.02	+ .01	74.3	−0.4	90	1	83	53	26	65	29		68	65			78	4.20	+0.2	12	3,152	ne.	36	nw.	9	8	10	13	5.8	.....	.....
Memphis	399	76	97	29.62	30.03	+ .05	77.8	−1.4	93	4	86	60	30	70	22		71	69			79	2.55	−0.6	10	4,149	e.	42	nw.	7	16	10	5	3.9	.....	.....
Nashville	546	168	191	29.45	30.03	+ .03	75.6	−2.2	94	1	85	53	26	66	30		68	65			74	3.02	−0.4	10	4,437	n.	38	nw.	22	15	8	8	4.2	.....	.....
Lexington	989	193	230	28.98	30.02	+ .01	74.4	−0.2	92	1	83	56	25	66	24		.....	.....			.....	1.94	−1.6	11	7,277	sw.	46	w.	29	15	10	6	4.2	.....	.....
Louisville	525	219	255	29.46	30.03	+ .03	75.5	−1.0	95	1	85	55	26	66	29		65	60			65	4.05	+0.5	8	6,342	s.	40	nw.	23	12	10	9	5.1	.....	.....
Evansville	431	139	175	29.56	30.01	+ .02	76.6	−0.4	97	5	86	57	25	67	25		66	62			66	1.92	−1.3	6	5,837	s.	30	sw.	24	12	17	2	4.8	.....	.....
Indianapolis	822	194	230	29.14	30.02	+ .02	72.5	−1.1	94	1	82	53	25	63	29		63	58			67	1.48	−1.8	6	6,686	sw.	33	w.	24	13	8	10	5.0	.....	.....
Terre Haute	575	96	129	29.39	30.00	.....	72.6	.....	96	1	82	51	25	63	30		65	61			73	1.99	.....	10	5,399	ne.	30	sw.	7	7	20	4	5.4	.....	.....
Cincinnati	623	11	51	29.35	30.01	.00	73.2	+1.6	93	5	84	54	25	63	32		65	61			70	1.70	−1.6	11	3,900	s.	21	sw.	24	11	15	5	4.5	.....	.....
Columbus	824	173	222	29.16	30.02	+ .01	72.4	−0.6	94	1	82	51	26	63	30		65	62			74	3.10	−0.1	7	6,653	nw.	40	nw.	8	18	7	6	4.1	.....	.....
Dayton	899	181	216	29.05	29.93	.....	72.6	−1.0	94	1	82	54	25	63	28		65	61			72	3.74	+0.7	10	5,687	sw.	45	ne.	20	10	16	5	4.8	.....	.....
Pittsburgh	842	353	410	29.13	30.02	+ .01	72.2	−0.3	93	1	81	52	26	63	26		61	60			73	4.75	+1.6	11	6,135	sw.	49	s.	7	11	11	9	5.2	.....	.....
Elkins	1,940	41	59	28.04	30.04	+ .02	69.4	+1.0	91	1	83	41	26	56	40		46	59			82	3.26	−0.4	11	1,965	w.	14	w.	25	9	14	8	5.3	.....	.....
Parkersburg	638	77	84	29.38	30.03	+ .02	73.6	+0.3	94	1	84	49	26	63	33		66	63			78	2.18	−1.4	11	2,853	se.	23	nw.	29	15	7	9	4.5	.....	.....
Lower Lake Region.							**69.5**	**−0.1**													**72**	**3.05**	**+0.1**											**5.0**		
Buffalo	767	247	280	29.18	30.00	+0.01	68.2	−0.6	88	5	75	52	18	61	26		62	58			73	1.86	−1.1	12	10,201	sw.	48	sw.	24	8	12	11	5.9	.....	.....
Canton	448	10	61	29.50	29.97	.....	67.8	0.0	94	1	78	45	31	58	34		.....	.....			.....	4.50	+1.8	14	6,542	sw.	34	sw.	25	14	10	7	4.4	.....	.....
Oswego	335	76	91	29.62	29.99	.00	68.6	−0.2	93	1	76	48	31	61	27		62	59			75	2.05	−0.6	12	6,116	s.	26	sw.	8	11	13	7	5.0	.....	.....
Rochester	523	97	113	29.45	30.01	+ .02	69.0	+0.7	94	1	78	48	31	60	28		61	57			71	2.51	−0.4	9	5,044	sw.	24	sw.	13	11	11	9	5.2	.....	.....
Syracuse	597	97	113	29.38	30.02	+ .03	69.4	+0.8	94	1	78	50	31	61	28		62	58			72	2.88	−0.4	12	6,613	s.	30	s.	3	9	13	9	5.5	.....	.....
Erie	714	130	166	29.24	30.00	− .01	69.6	−0.3	95	1	77	53	26	62	27		62	59			71	3.69	+0.4	14	8,793	sw.	36	sw.	1	8	16	7	4.9	.....	.....
Cleveland	762	190	201	29.20	30.01	.00	69.8	−0.6	95	1	77	52	25	63	26		63	60			73	4.65	+1.5	9	7,952	s.	36	nw.	5	8	16	7	5.5	.....	.....
Sandusky	629	62	103	29.33	30.00	− .01	70.8	−0.7	99	1	79	51	26	63	25		64	60			72	3.99	+0.6	12	7,163	sw.	54	n.	16	10	12	9	5.2	.....	.....
Toledo	628	208	243	29.34	30.01	+ .01	71.2	+0.3	96	1	80	50	25	62	28		63	59			70	1.83	−0.9	11	8,029	sw.	39	sw.	27	13	13	6	4.1	.....	.....
Fort Wayne	856	113	124	29.11	30.02	.....	70.3	−0.8	95	1	80	50	25	60	29		62	58			71	4.55	.....	10	5,183	sw.	48	sw.	5	14	13	4	4.2	.....	.....
Detroit	730	218	245	29.22	30.00	− .01	69.8	−0.1	94	1	78	50	25	62	27		62	58			71	2.56	−0.2	10	7,179	e.	34	w.	5	9	11	11	5.4	.....	.....
Upper Lake Region.							**64.1**	**−2.2**													**76**	**2.00**	**−1.0**											**5.1**		
Alpena	609	13	92	29.33	29.99	−0.01	62.4	−1.4	89	1	72	41	26	53	31		58	56			79	2.15	−1.2	11	7,359	nw.	31	se.	31	8	17	6	4.7	.....	.....
Escanaba	612	54	60	29.32	29.97	− .02	60.8	−3.7	83	1	69	42	25	52	26		57	54			81	3.13	−0.5	12	6,563	s.	38	sw.	26	13	10	8	4.9	.....	.....
Grand Haven	632	54	92	29.32	29.99	.00	65.6	−2.2	83	4	74	46	30	58	28		60	56			75	0.55	−2.0	6	6,719	w.	31	w.	24	17	8	6	3.8	.....	.....
Grand Rapids	707	70	87	29.24	30.00	.00	68.6	−1.4	88	19	79	47	25	58	34		60	55			69	0.46	−2.1	7	3,907	w.	20	nw.	25	10	15	6	4.6	.....	.....
Houghton	684	62	99	29.22	29.94	− .03	60.0	−3.3	82	31	69	40	30	51	30		.....	.....			.....	4.38	+1.5	8	7,007	w.	38	w.	1	12	9	10	5.1	.....	.....
Lansing	878	11	62	29.07	30.00	.....	67.0	−1.6	92	5	78	45	26	56	33		60	57			86	1.47	−1.2	11	3,235	sw.	38	sw.	27	11	9	11	5.4	.....	.....
Ludington	637	60	66	29.30	29.99	.....	63.0	.....	79	4	70	44	30	56	29		59	56			79	1.00	.....	8	6,588	s.	29	s.	27	14	10	7	4.2	.....	.....
Marquette	734	77	111	29.19	30.00	+ .02	60.4	−3.1	87	15	70	42	21	51	29		56	53			79	3.28	+0.4	12	7,453	nw.	55	se.	4	6	13	12	6.4	.....	.....
Port Huron	638	70	120	29.31	30.00	.00	66.8	−0.5	93	1	76	47	25	58	30		61	58			76	2.42	−0.2	11	6,558	ne.	52	nw.	5	10	17	4	4.5	.....	.....
Saginaw	641	48	82	29.31	30.00	.....	67.4	.....	92	5	78	46	25	56	32		60	57			74	1.98	−0.9	9	5,243	w.	25	sw.	27	5	9	17	7.0	.....	.....
Sault Sainte Marie	614	11	61	29.29	29.98	− .01	58.8	−1.8	82	15	69	38	26	49	34		55	53			85	2.25	−0.9	15	5,953	w.	34	nw.	25	5	14	12	6.5	.....	.....
Chicago	823	140	310	29.13	30.00	.00	70.4	−0.8	90	5	77	47	25	64	31		63	58			68	1.24	−1.6	7	7,141	ne.	31	s.	26	15	10	6	4.2	.....	.....
Green Bay	617	109	144	29.31	29.97	− .02	64.6	−2.4	86	15	74	40	25	56	29		59	55			75	2.07	−1.0	9	7,518	sw.	28	w.	4	11	10	10	5.6	.....	.....
Milwaukee	681	119	133	29.27	30.00	.00	68.0	−0.7	88	19	76	44	25	60	31		60	57			72	0.58	−2.2	3	6,378	w.	28	n.	16	13	14	4	4.2	.....	.....
Duluth	1,133	11	47	28.76	29.97	.00	59.8	−5.3	86	19	70	40	29	50	33		55	52			78	2.04	−1.5	9	8,794	w.	56	nw.	23	12	9	10	5.1	.....	.....
North Dakota.							**65.0**	**−0.8**													**60**	**0.87**	**−1.4**											**3.3**		
Moorhead	940	8	57	28.97	29.98	+0.02	66.4	+0.5	94	17	80	41	29	52	38		58	53			71	0.77	−2.3	6	5,647	nw.	36	nw.	23	21	8	2	2.4	.....	.....
Bismarck	1,674	8	57	28.24	30.01	+ .07	66.6	−1.5	95	17	81	38	28	52	41		55	46			56	1.37	−0.6	8	6,677	nw.	50	nw.	22	19	6	6	3.3	.....	.....
Devils Lake	1,482	11	44	28.39	29.94	.00	64.4	−0.7	96	17	79	36	28	50	39		54	47			60	1.12	−1.6	7	7,230	nw.	38	n.	26	18	7	6	4.0	.....	.....
Grand Forks	835	12	89	.....	.....	.....	64.4	.....	96	17	79	36	29	50	44		.....	.....			.....	1.58	.....	7	.....	s.	39	se.	4	23	4	4	.....	.....	.....
Williston	1,872	41	48	28.01	29.95	+ .02	66.2	−1.7	95	16	81	40	10	52	43		54	45			55	0.21	−1.1	4	5,789	n.	42	nw.	22	15	16	0	3.5	.....	.....
Upper Mississippi Valley.							**70.5**	**−2.4**													**70**	**2.47**	**−0.8**											**4.6**		
Minneapolis	918	10	208	29.02	29.96	.....	67.4	.....	91	4	77	46	29	58	30		.....	.....			.....	2.83	−0.9	5	8,154	nw.	39	nw.	23	14	10	7	4.2	.....	.....
St. Paul	837	201	236	29.07	29.96	−0.01	66.5	−3.0	93	4	76	45	29	56	33		.....	.....			.....	2.82	−0.6	7	8,111	nw.	42	nw.	23	14	14	3	4.3	.....	.....
La Crosse	714	11	48	29.22	29.98	.00	66.5	−3.5	90	19	77	44	30	56	32		.....	.....			.....	2.51	−0.9	8	2,987	s.	18	w.	4	16	6	9	4.6	.....	.....
Madison	974	70	78	28.98	30.00	+ .01	67.0	−2.6	88	4	76	45	25	58	32		60	56			72	2.72	−0.5	7	5,304	w.	26	nw.	24	9	9	13	5.5	.....	.....
Wausau	1,247	4	.....	28.66	29.98	.....	61.8	.....	86	19	73	37	30	51	33		.....	.....			.....	3.63	.....	9	.....	nw.	.....	.....	.....	13	9	9	4.7	.....	.....
Charles City	1,015	10	49	28.94	30.00	+ .03	67.0	−3.7	93	4	79	43	28	55	36		60	56			73	1.09	−1.7	7	3,670	nw.	24	s.	31	13	14	4	4.5	.....	.....
Davenport	606	71	79	29.36	30.01	+ .03	71.2	−1.8	92	4	82	50	25	61	32		62	57			65	0.70	−2.9	9	4,375	nw.	27	sw.	19	10	11	10	5.5	.....	.....
Des Moines	861	84	97	29.10	29.99	+ .02	70.9	−2.1	96	4	82	50	28	60	33		61	56			63	1.82	−1.8	11	4,207	nw.	35	sw.	4	15	11	5	4.3	.....	.....
Dubuque	698	81	96	29.28	30.02	+ .04	68.6	−3.4	91	20	79	47	25	58	34		60	58			68	2.11	−0.9	6	3,755	nw.	24	nw.	24	15	10	6	4.4	.....	.....
Keokuk	614	64	78	29.35	30.01	+ .03	72.3	−2.3	93	4	82	52	25	62	32		64	60			70	1.37	−1.9	6	4,205	sw.	28	w.	24	15	13	3	3.6	.....	.....
Cairo	356	87	93	29.62	29.99	.00	76.1	−1.1	94	1	84	58	30	68	22		69	66			76	6.36	+3.4	8	4,286	s.	24	n.	1	10	15	6	4.9	.....	.....
Peoria	609	11	45	29.36	30.02	+ .03	70.8	−1.7	92	19	82	46	25	60	34		63	59			74	3.36	+0.4	9	3,300	nw.	25	s.	20	15	10	6	3.9	.....	.....
Springfield, Ill.	644	10	91	29.33	29.99	.00	72.4	−1.6	93	4	82	52	25	63	28		64	60			72	2.35	−0.4	9	4,467	nw.	32	nw.	5	12	10	9	4.7	.....	.....
Hannibal	534	74	109	29.44	30.01	+ .03	72.1	−2.9	95	4	83	50	30	62	32		.....	.....			.....	1.87	−1.5	10	4,878	sw.	42	sw.	20	13	10	9	4.5	.....	.....
St. Louis	567	265	303	29.40	30.00	+ .01	75.3	−1.9	94	5	83	58	29	67	25		66	62			69	1.99	−0.7	10	7,142	s.	44	s.	7	9	18	4	5.2	.....	.....
Missouri Valley.							**71.3**	**−2.5**													**67**	**3.06**	**−0.2**											**3.9**		
Columbia, Mo.	781	11	84	29.18	30.00	+0.03	72.3	−2.4	97	3	82	51	10	62	32		.....	.....			.....	5.27	+2.2	11	4,057	se.	26	nw.	24	12	8	11	5.1	.....	.....
Kansas City	963	161	181	28.99	30.00	+ .03	73.6	−2.2	98	3	82	55	29	65	27		64	60			65	3.27	−1.5	10	6,406	n.	62	nw.	8	16	11	4	3.9	.....	.....
St. Joseph	907	11	49	28.98	30.00	.....	72.8	.....	98	4	83	51	29	62	30		64	60			71	5.08	.....	14	4,295	e.	28	nw.	23	15	12	4	3.6	.....	.....
Springfield, Mo.	1,324	98	104	28.64	30.02	+ .05	72.8	−2.0	90	5	82	53	30	64	24		65	62			75	4.26	0.0	10	5,790	s.	32	no.	9	15	9	7	4.1	.....	.....
Iola	984	11	50	28.97	30.00	+ .04	74.1	−2.2	98	3	86	48	30	63	33		.....	.....			.....	3.91	+0.4	14	3,544	se.	30	ne.	9	15	11	5	3.8	.....	.....
Topeka	987	85	101	.....	.....	.....	72.8	−3.2	99	3	83	50	29	63	31		.....	.....			.....	5.58	+1.3	13	5,204	s.	38	n.	8	18	7	6	3.5	.....	.....
Drexel	1,299	10	54	28.64	30.01	.....	69.4	.....	97	4	81	47	28	58	32		62	58			75	3.77	.....	9	5,805	s.	38	nw.	4	16	12	3	3.6	.....	.....
Lincoln	1,189	11	84	28.76	30.00	+ .05	71.6	−2.7	102	4	84	47	28	60	36		62	58			70	2.49	−1.2	9	5,819	sw.	60	nw.	4	16	12	3	3.7	.....	.....
Omaha	1,105	115	122	28.85	30.01	+ .05	71.8	−2.6	99	4	82	51	28	62	29		62	57			65	3.65	0.0	8	4,668	nw.	38	nw.	4	18	7	6	3.9	.....	.....
Valentine	2,598	47	54	27.34	30.02	+ .08	68.1	−3.2	98	3	82	44	29	54	42		57	51			61	0.95	−1.9	8	6,470	s.	31	s.	3	17	10	4	4.0	.....	.....
Sioux City	1,135	94	164	28.81	30.00	+ .05	70.4	−2.2	95	4	82	46	28	59	33		61	55			65	2.66	−0.3	5	7,281	s.	42	e.	6	17	9	5	3.2	.....	.....
Huron	1,306	59	74	28.62	30.00	+ .05	67.6	−1.5	94	26	80	41	28	55	36		59	53			64	0.79	−1.8	7	7,056	se.	34	nw.	4	17	12	2	3.4	.....	.....
Pierre	1,572	70	75	28.35	29.98	+ .04	71.0	−2.1	97	30	85	45	28	57	42		59	52			59	1.93	−0.1	8	6,286	nw.	37	nw.	4	15	12	4	3.9	.....	.....
Yankton	1,233	49	57	28.68	29.98	+ .03	69.6	−3.2	93	22	81	46	28	58	33		.....	.....			.....	2.98	−0.1	6	4,809	se.	27	nw.	22	10	17	4	4.7	.....	.....

TABLE I.—*Climatological data for Weather Bureau stations, August, 1917*—Continued.

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.												Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.						Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.						
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F*		°*F.*	°*F.*		°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	°*F.*	%	*In.*	*In.*		*Miles.*								*0–10.*	*In.*	*In.*
Northern Slope.							**65.1**	**−1.6**												**55**	**0.78**	**−0.5**										**3.8**		
Billings	3,140	5					66.8		97	21	86	40	23	48	50						0.26		2		sw.									
Havre	2,505	11	44	27.40	30.00	+0.09	65.5	−1.4	94	16	81	35	27	50	43	54	46	59	0.43	−0.8	4	4,210	nw.	43	nw.	21	21	6	4	3.2			
Helena	4,110	87	114	25.88	30.00	+ .06	66.2	+0.1	92	2	81	42	31	51	40	51	40	45	0.20	−0.5	5	5,849	sw.	39	nw.	30	17	11	3	3.6			
Kalispell	2,962	11	34	26.97	29.98	+ .05	63.5	+0.6	90	25	80	37	8	47	44	50	41	52	0.32	−0.6	3	3,172	w.	26	n.	30	14	15	2	4.0			
Miles City	2,371	48	55	27.51	30.02	+ .09	70.0	−1.5	96	21	84	44	9	56	38	58	50	57	0.56	−0.5	6	3,880	e.	30	nw.	22	21	10	0	2.7			
Rapid City	3,259	50	58	26.68	30.04	+ .11	67.2	−1.6	97	3	80	43	9	54	40	54	45	50	1.36	−0.8	7	5,778	w.	38	nw.	22	15	13	3	3.6			
Cheyenne	6,088	84	101	24.14	30.01	+ .09	61.4	−4.4	88	3	74	40	28	49	37	51	45	61	1.75	+0.3	10	7,399	w.	48	w.	4	10	14	7	5.0			
Lander	5,372	60	68	24.76	30.02	+ .10	64.2	−1.5	92	25	81	40	6	47	45	50	38	48	0.31	−0.2	6	3,242	w.	28	w.	9	16	15	0	3.5			
Sheridan	3,790	10	47	26.19	30.01		64.0		95	3	82	37	23	46	50	51	41	54	0.83		8	3,421	nw.	36	nw.	30	12	10	9	4.5			
Yellowstone Park	6,200	11	48	24.02	30.04	+ .11	58.6	−2.3	83	24	75	36	12	42	45	45	36	52	0.17	−0.8	4	4,701	sw.	33	s.	3	11	16	4	4.6			
North Platte	2,821	11	51	27.15	30.04	+ .10	69.4	−2.6	98	3	83	43	28	55	39	59	55	70	1.96	−0.5	11	4,289	s.	26	sw.	19	19	7	5	3.7			
Middle Slope.							**72.9**	**−2.3**												**65**	**3.01**	**+0.6**										**4.4**		
Denver	5,292	106	113	24.84	30.01	+0.09	68.4	−2.0	93	3	81	46	28	56	39	55	46	52	0.05	−1.3	4	5,221	s.	36	w.	26	12	12	7	4.6			
Pueblo	4,685	80	86	25.39	30.00	+ .09	70.4	−1.7	96	3	84	47	29	56	44	56	48	56	1.74	+0.2	9	4,537	se.	40	w.	10	14	11	6	4.6			
Concordia	1,392	50	58	28.56	30.01	+ .06	72.8	−3.7	102	4	85	48	29	61	36	63	58	68	2.63	−0.2	15	4,670	s.	36	nw.	21	12	14	5	4.6			
Dodge City	2,509	11	51	27.44	29.99	+ .06	73.6	−2.9	100	4	85	45	29	62	35	64	59	71	4.46	+1.9	13	6,527	se.	28	ne.	9	17	7	7	3.8			
Wichita	1,358	139	158	28.57	29.98	+ .03	74.7	−2.8	96	4	84	49	29	65	29	66	62	70	4.69	+1.6	11	7,149	s.	37	s.	26	19	4	8	3.5			
Altus	1,410	5					81.5		103	14	95	50	29	68	39				4.58		11		se.				15	7	9					
Muskogee	652	4					77.6		101	1	89	55	30	66	30				9.06		13		s.				18	2	11					
Oklahoma	1,214	10	47	28.73	29.98	+ .04	77.7	−0.8	97	4	88	52	29	67	30	68	64	73	4.50	+1.3	13	7,350	s.	50	n.	8	8	15	8	5.1			
Southern Slope.							**80.2**	**+1.1**												**59**	**2.89**	**+0.7**										**3.6**		
Abilene	1,738	10	52	28.17	29.92	0.00	83.8	+2.6	104	22	96	53	30	72	33	66	57	48	1.24	−0.7	9	6,426	s.	35	nw.	5	13	15	3	4.3			
Amarillo	3,676	10	49	26.32	29.98	+ .06	74.0	−0.6	95	7	85	49	29	63	30	63	59	67	6.17	+3.4	15	7,147	s.	39	s.	10	19	9	3	3.8			
Del Rio	944	64	71	28.96	29.92	+ .02	86.4	+2.4	106	23	97	66	24	76	33				0.92	−1.6	5	7,431	e.	42	n.	24	21	10	0	2.3			
Roswell	3,566	75	85	26.39	29.92	+ .04	76.6	0.0	100	8	89	54	30	64	34	64	58	61	3.25	+1.8	10	5,117	s.	40	ne.	1	13	17	1	3.9			
Southern Plateau.							**77.0**	**−0.3**												**54**	**1.23**	**+0.1**										**3.0**		
El Paso	3,762	110	133	26.20	29.87	+0.03	79.2	+0.6	99	8	91	58	29	67	33	63	54	50	4.39	+2.7	10	6,360	se.	53	nw.	29	15	14	2	3.4			
Santa Fe	7,013	57	66	23.37	29.89	.00	67.8	−0.8	89	8	79	48	29	56	30	53	45	54	1.37	−1.0	11	4,826	e.	28	nw.	18	4	25	2	5.2			
Flagstaff	6,908	8	57	23.49	29.93	+ .09	62.6	−0.2	83	8	78	38	20	47	42				1.11		8		w.	37	w.	26	18	13	0				
Phoenix	1,108	11	81	28.70	29.81	+ .02	87.2	+1.8	107	28	102	58	20	72	45	69	60	46	0.11	−0.8	1	3,403	w.	42	e.	2	25	6	0	1.4			
Yuma	141	9	54	29.67	29.81	+ .05	90.2	+0.1	110	6	106	65	20	75	42	71	62	49	0.23	−0.1	2	3,479	sw.	46	s.	8	27	4	0	1.6			
Independence	3,910	11	42	26.01	29.97	+ .16	75.1	−1.3	98	6	93	51	13	58	41	56	41	35	0.03	−0.1	1		w.				17	9	5	3.6				
Needles	488	4		29.29	29.77		91.4		114	6	108	60	20	74	49				0.47		3		e.				26	1	4					
Middle Plateau.							**72.2**	**+0.6**												**38**	**0.44**	**−0.3**										**3.0**		
Reno	4,532	74	81	25.53	29.94	+0.10	72.0	+5.0	97	23	89	48	27	55	43	53	39	39	0.12	−0.1	2	4,181	w.	38	w.	24	21	6	4	2.7			
Tonopah	6,090	12	20	24.17	29.96		72.4		89	2	83	54	12	62	26	52	37	32	0.58	+0.2	5	5,018	se.	38	se.	24	18	11	2	2.8			
Winnemucca	4,344	18	56	25.67	29.98	+ .10	71.0	+0.2	97	2	90	42	7	52	48	51	36	36	0.57	+0.4	3	4,006	ne.	35	sw.	15	22	5	4	2.5			
Modena	5,479	10	43	24.70	29.94	+ .08	69.4	+0.8	92	23	86	42	27	53	42	51	37	41	0.26	−1.6	7	7,185	w.	46	w.	25	16	8	7	4.1			
Salt Lake City	4,360	163	203	25.67	29.95	+ .04	73.9	−1.6	92	9	86	57	28	62	31	55	40	34	0.71	−0.1	3	4,871	nw.	44	nw.	3	18	13	0	2.8			
Grand Junction	4,602	82	96	25.44	29.97	+ .07	74.6	−1.5	98	8	88	55	28	61	35	56	42	39	0.38	−0.7	6	5,616	se.	54	nw.	10	23	5	3	2.9			
Northern Plateau.							**72.2**	**+1.9**												**37**	**0.01**	**−0.4**										**2.0**		
Baker	3,471	48	53	26.50	30.03	+0.08	66.8	+1.9	95	2	84	44	8	50	45	52	41	43	0.02	−0.4	1	4,290	nw.	23	w.	15	20	10	1	2.2			
Boise	2,739	78	86	27.16	29.96	+ .03	74.0	+2.2	97	2	90	50	11	58	41	57	46	40	T.	−0.2	0	3,133	nw.	27	sw.	3	23	7	1	1.9			
Lewiston	757	40	48	29.18	29.98	+ .03	75.3	+1.8	103	16	93	51	8	57	47				0.00	−0.4	0	1,834	w.	23	nw.	3	24	6	1	1.7			
Pocatello	4,477	60	68	25.53	29.96	+ .04	69.2	−1.3	94	25	85	47	8	53	41	51	35	36	0.04	−0.5	2	5,461	se.	38	sw.	3	20	8	3	2.6			
Spokane	1,929	101	110	27.97	29.98	+ .03	71.4	+3.5	97	17	87	49	23	56	42	53	37	35	T.	−0.5	0	3,926	sw.	25	w.	6	19	12	0	2.7			
Walla Walla	991	57	65	28.92	29.97	+ .01	76.8	+3.0	100	16	91	54	8	62	39	57	41	31	T.	−0.4	0	2,894	s.	13	w.	6	30	1	0	1.2			
North Pacific Coast Region.							**63.0**	**+1.1**												**74**	**0.29**	**−0.5**										**3.3**		
North Head	211	11	56	29.88	30.10	+0.07	54.6	−3.3	76	31	58	47	12	52	24	54	53	97	0.57	0.0	14	10,640	nw.	36	nw.	10	6	7	18	6.9			
North Yakima	1,071	4					74.2		98	16	91	49	23	57	45				0.00		0		nw.				29	1	1					
Port Angeles	42	8	48	30.08	30.12		57.2		76	31	67	43	5	48	30				0.03	−0.6	1	4,243	nw.	26	nw.	9	25	2	4	2.5			
Seattle	125	215	250	29.96	30.10	+ .10	65.2	+2.1	83	16	75	52	8	55	28	57	52	67	0.03	−0.5	2	4,727	n.	23	n.	8	21	7	3	3.2			
Tacoma	213	113	12)	29.86	30.09	+ .07	64.8	+1.8	83	16	76	51	30	54	28	57	51	66	0.04	−0.7	1	3,738	n.	24	w.	6	16	11	4	3.6			
Tatoosh Island	109	7	57	30.01	30.11	+ .11	54.0	−1.3	67	31	58	45	30	50	18	53	52	95	1.39	−0.7	6	8,653	s.	35	s.	5	19	5	7	3.8			
Medford	1,425	4					72.1		105	23	91	44	6	53	53				0.09		1		nw.				23	6	2					
Portland, Oreg.	153	63	106	29.87	30.03	+ .02	70.3	+4.4	92	12	82	51	10	58	36	60	53	58	T.	−0.6	0	4,469	nw.	18	nw.	10	21	8	2	2.3			
Roseburg	510	9	57	29.48	30.02	+ .02	69.4	+3.2	93	1	86	48	10	53	42	59	51	61	T.	−0.3	0	1,837	n.	18	nw.	10	27	4	0	1.1			
Middle Pacific Coast Region.							**65.2**	**+0.4**												**62**	**0.00**	**0.0**										**4.2**		
Eureka	62	73	89	29.98	30.05	+0.03	54.0	−1.8	64	20	58	48	8	50	11	52	51	90	0.02	−0.1	1	3,943	sw.	18	sw.	16	1	6	24	8.6			
Mount Tamalpais	2,375	11	18	27.55	29.98	+ .03	70.8	+4.9	87	10	79	47	8	63	27	56	44	40	0.00	0.0	0	8,872	w.	60	nw.	5	28	3	0	0.9			
Point Reyes Light	490	7	18	29.45	29.97		53.6	−0.9	62	26	57	48	6	50	10				T.		0	11,586	nw.	54	nw.	20	0	5	26	9.4			
Red Bluff	332	50	56	29.53	29.87	+ .01	82.2	+1.2	108	11	98	60	17	66	41	61	45	33	0.00	0.0	0	2,892	se.	20	n.	25	27	3	1	1.0			
Sacramento	69	106	117	29.83	29.90	+ .05	72.6	+0.5	99	10	90	50	9	56	43	61	54	61	T.	0.0	0	5,993	s.	22	s.	12	28	3	0	0.8			
San Francisco	155	209	213	29.82	29.99	+ .07	57.6	−0.4	69	20	63	50	5	52	17	54	52	86	T.	0.0	0	8,705	sw.	36	sw.	10	7	14	10	5.8			
San Jose	141	12	110	29.84	29.99		65.8	−0.9	86	10	77	46	6	54	38				0.00	0.0	0	4,024	nw.	17	se.	11	19	12	0	3.2			
South Pacific Coast Region.							**70.8**	**+0.3**												**67**	**T.**	**0.0**										**2.6**		
Fresno	327	89	98	29.53	29.87	+0.05	81.2	0.0	104	5	98	58	17	64	41	61	46	36	T.	0.0	0	5,724	nw.	24	nw.	2	29	1	1	0.9			
Los Angeles	338	159	191	29.59	29.95	+ .07	70.0	+1.4	88	4	79	56	29	61	25	62	59	77	T.	0.0	0	3,932	sw.	18	sw.	23	23	8	0	2.6			
San Diego	87	62	70	29.85	29.94	+ .05	68.6	−0.1	78	4	73	60	19	64	13	64	61	80	T.	0.0	0	4,661	nw.	17	w.	1	20	10	1	3.3			
San Luis Obispo	201	32	40	29.79	30.01	+ .07	63.5	0.0	84	4	74	50	6	53	32	56	52	75	0.00	0.0	0	2,873	w.	12	w.	1	11	20	0	3.6			
West Indies.																																		
San Juan, P. R	82	8	54	29.94	30.02	+0.05	79.8		89	11	84	73	29	75	14	75	73	78	3.97	−3.4	22	10,132	e.	36	e.	27	12	16	3	4.8			
Panama Canal.																																		
Balboa Heights	118	7	97	29.76	29.88		79.4		89	16	86	71	31	73	16	75	74	92	7.42	−0.6	23	4,277	nw.	36	n.	13	0	10	21	8.0			
Colon	36	5	97	29.84	29.88		78.8		86	8	83	72	7	75	11	76	75	90	1.58	+0.9	29	5,302	nw.	24	n.	16	0	5	26	8.6			
Alaska.																																		
Juneau	80	11	49				54.6		78	6	61	40	31	48	30	52	51	91	11.08		22	2,788	s.	18	se.	27	4	6	21	7.6			

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during August, 1917, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex.	19			0.43														0.32			
Albany, N. Y.	29			0.87														0.41			
Alpena, Mich.	7			0.53														0.36			
Amarillo, Tex.	19	D.N.a.m.	7:27 a.m.	1.03	2:03 a.m.	2:30 a.m.	0.01	0.12	0.29	0.37	0.41	0.54	0.57								
Anniston, Ala.	2	6:12 a.m.	9:40 a.m.	1.98	6:12 a.m.	7:12 a.m.	0.00	0.06	0.16	0.37	0.59	0.76	0.90	1.01	1.18	1.35	1.44	1.59			
	2	7:31 p.m.	9:55 p.m.	1.94	7:31 p.m.	8:01 p.m.	0.00	0.30	0.74	1.11	1.45	1.65	1.75								
	7	7:45 a.m.	9:50 a.m.	1.35	8:09 a.m.	8:36 a.m.	0.13	0.26	0.38	0.58	0.86	1.14	1.18								
	8	12:17 a.m.	5:45 p.m.	1.25	12:19 p.m.	12:36 p.m.	0.01	0.16	0.58	0.88	0.91										
Asheville, N. C.	8	3:17 p.m.	3:42 p.m.	0.68	3:22 p.m.	3:36 p.m.	0.01	0.28	0.57	0.67											
	31	4:55 p.m.	D.N.a.m.	1.54	9:41 p.m.	10:03 p.m.	0.41	0.06	0.19	0.36	0.50	0.53									
Atlanta, Ga.	14	10:45 a.m.	11:40 a.m.	0.90	10:50 a.m.	11:05 a.m.	0.01	0.34	0.62	0.72											
Atlantic City, N. J.	17	1:42 p.m.	3:56 p.m.	1.65	1:55 p.m.	2:39 p.m.	0.02	0.11	0.31	0.62	0.92	1.01	1.13	1.35	1.46	1.50					
Augusta, Ga.	8	11:15 a.m.	1:05 p.m.	0.81	11:25 a.m.	11:33 a.m.	0.02	0.38	0.50												
Baker, Oreg.	17			0.02														0.02			
Baltimore, Md.	1	3:00 a.m.	4:20 a.m.	0.70	3:02 a.m.	3:21 a.m.	0.01	0.12	0.38	0.56	0.63										
Bentonville, Ark.	28			1.39														0.56			
Binghamton, N. Y.	2	2:08 p.m.	3:40 p.m.	0.59	2:27 p.m.	2:42 p.m.	0.01	0.20	0.47	0.55											
	8	4:45 p.m.	5:00 a.m.	2.73	8:49 p.m.	10:14 p.m.	0.43	0.09	0.18	0.56	0.78	0.97	1.10	1.22	1.24	1.26	1.29	1.36	1.86	1.99	
	23	4:45 p.m.	D.N.p.m.	0.99	9:13 p.m.	9:37 p.m.	0.32	0.12	0.19	0.25	0.40	0.46									
	28	7:55 p.m.	10:15 p.m.	0.60	8:34 p.m.	8:44 p.m.	0.15	0.42													
Birmingham, Ala.	1	1:32 p.m.	3:19 p.m.	1.76	1:46 p.m.	2:40 p.m.	0.01	0.15	0.47	0.79	0.95	1.04	1.15	1.41	1.50	1.59	1.65	1.73			
	2–3	9:15 p.m.	D.N.a.m.	2.47	9:19 p.m.	10:12 p.m.	0.01	0.28	0.75	1.25	1.55	1.70	1.81	1.89	1.98	2.10	2.27	2.37			
	13	5:01 p.m.	5:44 p.m.	0.86	5:07 p.m.	5:27 p.m.	0.02	0.08	0.36	0.60	0.82										
	29	7:00 p.m.	7:45 p.m.	0.67	7:03 p.m.	7:16 p.m.	0.01	0.34	0.58	0.61											
Bismarck, N. Dak.	15	1:40 a.m.	D.N.a.m.	0.57	1:58 a.m.	2:10 a.m.	0.01	0.32	0.50	0.54											
Block Island, R. I.	17			0.35														0.34			
Boise, Idaho.	16			T.														T.			
Boston, Mass.	10	2:00 a.m.	10:00 a.m.	2.97	4:57 a.m.	5:47 a.m.	0.07	0.16	0.20	0.28	0.30	0.30	0.41	0.51	0.57	0.70	0.72				
					5:47 a.m.	6:37 a.m.	.....	0.73	0.79	0.28	0.99	1.28	1.41	1.50	1.59	1.65	1.73	.....	.....	.....	.....
					6:37 a.m.	7:23 a.m.	.....	1.81	1.87	1.94	2.01	2.08	2.19	2.33	2.44	2.57	.....				
	17	5:25 p.m.	8:20 p.m.	1.20	5:55 p.m.	6:14 p.m.	T.	0.50	0.73	0.87	0.93										
Buffalo, N. Y.	28			0.55														0.28			
Burlington, Vt.	1			0.44														0.54			
Cairo, Ill.	15	1:05 a.m.	9:12 a.m.	3.04	3:25 a.m.	4:42 a.m.	0.70	0.05	0.10	0.27	0.34	0.41	0.51	0.56	0.66	0.76	0.87	1.20	1.46		
	21	10:23 p.m.	D.N.p.m.	0.80	10:25 p.m.	10:59 p.m.	0.01	0.11	0.24	0.43	0.52	0.57	0.66	0.72							
Canton, N. Y.	17			1.26														0.39			
Charles City, Iowa.	4			0.63														0.45			
Charleston, S. C.	3	1:30 p.m.	5:40 p.m.	2.60	1:30 p.m.	2:14 p.m.	0.00	0.16	0.37	0.57	0.66	0.81	1.15	1.61	1.90	1.99					
Charlotte, N. C.	2	3:55 p.m.	8:07 p.m.	1.27	3:55 p.m.	4:26 p.m.	0.00	0.05	0.37	0.68	0.87	0.95	1.01	1.04							
	30	4:22 p.m.	5:36 p.m.	0.73	4:30 p.m.	4:50 p.m.	0.06	0.07	0.19	0.46	0.56										
	31	D.N.a.m.	10:15 a.m.	1.34	7:01 a.m.	7:44 a.m.	0.03	0.16	0.37	0.56	0.69	0.74	0.78	0.82	1.05	1.18					
Chattanooga, Tenn.	31	10:58 a.m.	12:25 p.m.	1.03	11:00 a.m.	11:15 a.m.	T.	0.33	0.62	0.87											
Cheyenne, Wyo.	19	11:50 a.m.	2:20 p.m.	0.65	12:08 p.m.	12:30 p.m.	0.03	0.17	0.25	0.41	0.51	0.56									
Chicago, Ill.	23			0.31														0.30			
Cincinnati, Ohio.	6			0.38														0.38			
Cleveland, Ohio.	13			1.62														0.65			
Columbia, Mo.	7	D.N.a.m.	D.N.a.m.	0.95	3:42 a.m.	4:22 a.m.	0.03	0.09	0.18	0.31	0.46	0.55	0.59	0.70	0.86						
Columbia, S. C.	8			1.02														0.29			
Columbus, Ohio.	22			1.47														0.72			
Concord, N. H.	9–10			1.71														?			
Concordia, Kans.	6			0.61														0.54			
Corpus Christi, Tex.	30			0.41														0.39			
Dallas, Tex.	18	2:09 p.m.	8:15 p.m.	1.67	2:20 p.m.	2:46 p.m.	0.01	0.12	0.22	0.47	0.69	0.85	0.88								
					3:56 p.m.	4:15 p.m.	0.97	0.15	0.28	0.46	0.57										
Davenport, Iowa.	7			0.19														0.12			
Dayton, Ohio.	21	8:09 p.m.	11:15 p.m.	0.93	8:22 p.m.	8:38 p.m.	0.02	0.18	0.41	0.53	0.56										
Del Rio, Tex.	24	4:05 p.m.	4:40 p.m.	0.56	4:07 p.m.	4:31 p.m.	0.01	0.06	0.18	0.34	0.45	0.55									
Denver, Colo.	17			0.01														0.01			
Des Moines, Iowa.	21	2:39 p.m.	5:18 p.m.	0.83	2:43 p.m.	3:18 p.m.	0.01	0.17	0.30	0.42	0.52	0.62	0.71	0.76							
Detroit, Mich.	5			0.71														0.39			
Devils Lake, N. Dak.	8			0.84														0.34			
Dodge City, Kans.	7	7:30 p.m.	9:15 p.m.	1.12	8:12 p.m.	8:53 p.m.	0.21	0.18	0.43	0.48	0.48	0.49	0.51	0.69	0.86	0.90					
	14–15	11:35 p.m.	D.N.a.m.	0.73	12:14 p.m.	12:41 a.m.	0.12	0.13	0.15	0.20	0.34	0.48	0.52								
Drexel, Nebr.	6	5:40 p.m.	9:10 p.m.	1.41	6:10 p.m.	6:38 p.m.	0.07	0.14	0.35	0.49	0.64	0.78	0.82								
Dubuque, Iowa.	7			1.68														0.61			
Duluth, Minn.	31			2.04														0.22			
Eastport, Me.	10	D.N.a.m.	6:45 a.m.	0.59	4:24 a.m.	4:43 a.m.	0.03	0.20	0.35	0.42	0.52										
	10	8:30 a.m.	6:15 p.m.	1.96	3:16 p.m.	3:56 p.m.	0.92	0.05	0.12	0.23	0.34	0.46	0.54	0.65	0.71						
Elkins, W. Va.	8			1.10														0.57			
El Paso, Tex.	12	4:30 p.m.	9:40 p.m.	0.63	4:43 p.m.	5:02 p.m.	0.01	0.11	0.29	0.50	0.58										
	15–16	10:35 p.m.	D.N.a.m.	1.12	10:50 p.m.	11:07 p.m.	0.01	0.21	0.64	0.86	0.92										
Erie, Pa.	24			0.72														0.55			
Escanaba, Mich.	26	4:40 p.m.	7:15 p.m.	0.83	6:47 p.m.	7:05 p.m.	0.32	0.16	0.32	0.44	0.51										
Eureka, Cal.	1			0.02														0.02			
Evansville, Ind.	22	6:25 p.m.	8:20 p.m.	1.13	7:12 p.m.	7:40 p.m.	0.07	0.22	0.53	0.78	0.89	0.97	1.01								
Flagstaff, Ariz.	2–3			0.25														*			
Fort Smith, Ark.	13	5:44 a.m.	12:58 p.m.	0.83	6:56 a.m.	7:13 a.m.	0.01	0.25	0.39	0.46	0.50										
Fort Wayne, Ind.	13	5:35 p.m.	7:05 p.m.	1.61	5:39 p.m.	6:36 p.m.	0.01	0.16	0.23	0.47	0.74	0.93	1.11	1.37	1.39	1.40	1.48	1.59			
	27	10:40 p.m.	D.N.p.m.	1.02	10:45 p.m.	11:12 p.m.	0.01	0.20	0.48	0.68	0.79	0.92	0.96								
Fort Worth, Tex.	28	8:08 a.m.	9:40 a.m.	0.53	8:15 a.m.	8:29 a.m.	0.01	0.23	0.40	0.50											
Fresno, Cal.	24			T.														T.			
Galveston, Tex.	28–29	D.N.p.m.	7:10 a.m.	1.30	4:51 a.m.	5:21 a.m.	0.18	0.05	0.17	0.35	0.71	0.88	0.94								
Grand Haven, Mich.	13			0.14														0.14			
Grand Junction, Colo.	13			0.22														0.11			
Grand Rapids, Mich.	12			0.14														0.12			
Green Bay, Wis.	7			0.45														0.33			
Hannibal, Mo.	7			0.56														0.46			
Harrisburg, Pa.	23	10:30 a.m.	7:58 p.m.	2.84	3:38 p.m.	5:15 p.m.	0.59	0.05	0.14	0.35	0.46	0.54	0.70	0.81	0.86						
					5:47 p.m.	6:13 p.m.	2.01	0.13	0.24	0.42	0.52	0.64	0.67								
Hartford, Conn.	21	7:20 p.m.	9:10 p.m.	2.68	7:49 p.m.	8:40 p.m.	0.01	0.27	0.76	1.18	1.57	1.88	2.11	2.28	2.45	2.52	2.58	2.64			
	29	7:30 p.m.	D.N.p.m.	2.19	8:02 p.m.	8:52 p.m.	0.01	0.18	0.23	0.35	0.48	0.57	0.61	0.63	0.64	0.77	0.85				
					8:52 p.m.	9:42 p.m.	.....	1.01	1.08	1.19	1.20	1.21	1.24	1.34	1.47	1.49	1.50	.....			
					9:42 p.m.	10:17 p.m.	.....	1.52	1.57	1.70	1.78	1.95	1.98	2.09							
Hatteras, N. C.	29			1.47														0.44			
Havre, Mont.	3			0.11														0.10			
Helena, Mont.	4			0.07														0.06			
Houghton, Mich.	23	3:42 p.m.	5:05 p.m.	1.07	3:42 p.m.	4:28 p.m.	0.00					0.63	0.70	0.76	0.90	1.02	1.05				
	27	1:50 a.m.	D.N.a.m.	0.75	2:15 a.m.	2:43 a.m.	0.09	0.18	0.42	0.45	0.52	0.61	0.65								
Houston, Tex.	28			0.63														0.55			
Huron, S. Dak.	11			0.34														0.15			

* Self-register not working. † Record partly estimated. ‡ No precipitation occurred during month.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during August, 1917, at all stations furnished with self-registering gages*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Independence, Cal.	11			0.03														*			
Indianapolis, Ind.	6			0.63														0.47			
Iola, Kans.	6–7	11:00 p. m.	D. N. a. m.	0.98	11:14 p. m.	11:39 p. m.	0.04	0.13	0.40	0.51	0.60	0.65									
Jacksonville, Fla.	5	1:55 p. m.	4:45 p. m.	1.16	2:09 p. m.	2:45 p. m.	0.04	0.14	0.20	0.23	0.29	0.34	0.45	0.56	0.73	0.83					
	16	10:13 a. m.	11:15 a. m.	0.63	10:13 a. m.	10:32 a. m.	0.00	0.14	0.31	0.43	0.53										
	19	1:45 p. m.	D. N. a. m.	1.25	3:30 p. m.	3:57 p. m.	0.17	0.12	0.28	0.38	0.44	0.52	0.57								
Juneau, Alaska	1			1.32														0.31			
Kalispell, Mont.	7			0.21														0.10			
Kansas City, Mo.	6–7			1.09														0.44			
Keokuk, Iowa	27			0.57														0.27			
Key West, Fla.	23	9:09 a. m.	D. N. p. m.	1.65	9:10 a. m.	9:26 a. m.	0.01	0.19	0.39	0.50	0.51										
Knoxville, Tenn.	9	4:05 p. m.	7:00 p. m.	1.36	5:02 p. m.	5:40 p. m.	0.19	0.13	0.50	0.70	0.73	0.78	0.87	0.95	0.98						
La Crosse, Wis.	7			0.55														0.32			
Lander, Wyo.	27			0.17														0.08			
Lansing, Mich.	7			0.43														0.26			
Lewiston, Idaho.	‡			‡																	
Lexington, Ky.	22			1.08														0.32			
Lincoln, Nebr.	6	5:45 p. m.	8:10 p. m.	0.93	6:58 p. m.	7:14 p. m.	0.13	0.18	0.43	0.61	0.66										
Little Rock, Ark.	7	5:07 p. m.	7:50 p. m.	1.20	5:28 p. m.	5:45 p. m.	0.02	0.23	0.60	0.94	0.99										
	13	11:45 a. m.	1:50 p. m.	0.60	Noon	12:12 p. m.	0.01	0.23	0.47	0.51											
	29	12:44 p. m.	2:15 p. m.	0.84	1:14 p. m.	1:29 p. m.	0.01	0.28	0.53	0.68											
Los Angeles, Cal.	24			T.														T.			
Louisville, Ky.	29	3:57 p. m.	7:20 a. m.	2.94	4:16 p. m.	5:28 p. m.	0.01	0.15	0.30	0.34	0.39	0.49	0.52	0.55	0.58	0.65	1.18	2.09	2.38		
Ludington, Mich.	24			0.42														0.15			
Lynchburg, Va.	16	6:50 p. m.	8:05 p. m.	0.89	7:02 p. m.	7:32 p. m.	0.01	0.21	0.41	0.55	0.74	0.81	0.86								
	30	12:25 p. m.	1:30 p. m.	1.19	12:28 p. m.	1:02 p. m.	0.01	0.20	0.28	0.34	0.64	1.01	1.13	1.16							
Macon, Ga.	6	3:47 p. m.	5:25 p. m.	0.77	4:28 p. m.	4:46 p. m.	0.06	0.34	0.51	0.62	0.67										
	15	2:26 p. m.	3:25 p. m.	1.76	2:28 p. m.	2:56 p. m.	0.02	0.22	0.66	0.98	1.34	1.68	1.74								
Madison, Wis.	7	6:10 a. m.	12:20 p. m.	1.35	9:06 a. m.	9:24 a. m.	0.42	0.09	0.36	0.51	0.55										
	7	6:39 p. m.	7:04 p. m.	0.57	6:54 p. m.	7:04 p. m.	0.01	0.23	0.56												
Marquette, Mich.	19	12:53 p. m.	3:20 p. m.	1.62	1:12 p. m.	1:45 p. m.	0.01	0.17	0.21	0.41	0.66	0.89	1.04	1.17							
Memphis, Tenn.	7	7:05 p. m.	D. N. p. m.	0.92	7:41 p. m.	7:55 p. m.	0.07	0.25	0.56	0.65											
	22	D. N. a. m.	D. N. a. m.	0.68	3:26 a. m.	3:55 a. m.	0.01	0.11	0.23	0.41	0.48	0.55	0.59								
Meridian, Miss.	22			0.49														0.43			
Miami, Fla.	20	5:41 p. m.	7:45 p. m.	0.70	5:47 p. m.	6:05 p. m.	0.01	0.14	0.29	0.52	0.60										
	31	5:27 p. m.	6:25 p. m.	0.63	5:29 p. m.	5:49 p. m.	0.01	0.20	0.28	0.44	0.57										
Milwaukee, Wis.	7			0.53														0.22			
Minneapolis, Minn.	7			1.64														0.53			
Mobile, Ala.	4	1:15 p. m.	5:10 p. m.	1.11	1:17 p. m.	1:47 p. m.	0.01	0.20	0.50	0.58	0.72	0.87	0.95								
	5	4:50 p. m.	7:45 p. m.	0.88	6:38 p. m.	7:21 p. m.	0.01	0.11	0.19	0.30	0.40	0.50	0.56	0.68	0.81	0.87					
	11	11:44 a. m.	1:15 p. m.	0.87	11:45 a. m.	11:59 a. m.	0.01	0.30	0.66	0.81											
Modena, Utah	10			0.08														0.08			
Montgomery, Ala.	8	4:03 p. m.	7:20 p. m.	0.78	4:14 p. m.	4:34 p. m.	0.03	0.12	0.36	0.55	0.63										
Moorhead, Minn.	4			0.37														0.31			
Mount Tamalpais, Cal.	‡			‡																	
Nantucket, Mass.	10			1.02														0.60			
Nashville, Tenn.	21			0.78														0.63			
Needles, Cal.	11			0.20														*			
New Haven, Conn.	17			0.86														0.67			
New Orleans, La.	6	11:50 a. m.	12:25 p. m.	0.43	Noon	12:16 p. m.	0.01	0.11	0.28	0.38	0.40										
	8	12:20 p. m.	1:45 p. m.	0.98	12:29 p. m.	12:44 p. m.	0.03	0.16	0.44	0.62											
	12	12:58 p. m.	2:30 p. m.	0.53	1:16 p. m.	1:36 p. m.	0.02	0.20	0.33	0.34	0.42										
	17	3:00 p. m.	7:30 p. m.	2.35	3:16 p. m.	4:16 p. m.	0.13	0.08	0.20	0.56	1.09	1.34	1.56	1.74	1.79	1.83	1.87	2.08			
	28	1:37 p. m.	2:55 p. m.	1.02	1:48 p. m.	2:27 p. m.	0.02	0.08	0.12	0.15	0.24	0.32	0.45	0.71	0.80						
New York, N. Y.	24			1.04														0.44			
Norfolk, Va.	9	2:10 p. m.	6:30 p. m.	1.62	2:24 p. m.	3:04 p. m.	0.01	0.15	0.36	0.61	0.76	0.91	1.09	1.23	1.33						
	31	2:37 p. m.	3:15 p. m.	1.60	2:40 p. m.	3:06 p. m.	0.02	0.11	0.35	0.99	1.31	1.55	1.57								
Northfield, Vt.	6			0.37														0.37			
North Head, Wash.	17			0.13														0.07			
North Platte, Nebr.	21	6:31 a. m.	7:12 a. m.	0.60	6:43 a. m.	7:01 a. m.	0.02	0.17	0.35	0.53	0.58										
Oklahoma, Okla.	13	2:33 a. m.	6:30 a. m.	0.78	2:36 a. m.	2:51 a. m.	0.01	0.15	0.44	0.70											
Omaha, Nebr.	6	6:30 p. m.	9:30 p. m.	1.08	6:47 p. m.	7:11 p. m.	0.01	0.23	0.39	0.61	0.67	0.75									
	19	2:50 p. m.	4:10 p. m.	0.70	3:05 p. m.	3:30 p. m.	0.01	0.09	0.19	0.36	0.50	0.64	0.66								
Oswego, N. Y.	9			0.69														0.68			
Palestine, Tex.	18			0.07														0.04			
Parkersburg, W. Va.	15			0.47														0.47			
Pensacola, Fla.	6	5:55 a. m.	6:40 a. m.	0.72	6:04 a. m.	6:14 a. m.	0.01	0.38	0.63	0.64											
	14	2:50 p. m.	4:20 p. m.	0.82	2:57 p. m.	3:10 p. m.	0.01	0.38	0.62	0.71											
	16	7:45 p. m.	9:35 p. m.	0.67	7:54 p. m.	8:19 p. m.	0.01	0.13	0.33	0.41	0.52	0.62									
	20	12:15 p. m.	1:45 p. m.	1.53	12:17 p. m.	12:56 p. m.	0.01	0.08	0.20	0.41	0.65	0.82	1.28	1.43	1.48						
	21	1:30 p. m.	3:30 p. m.	1.68	1:52 p. m.	2:28 p. m.	0.01	0.34	0.80	1.12	1.33	1.46	1.52	1.57	1.60						
	30	2:20 a. m.	3:50 a. m.	0.75	2:26 a. m.	2:47 a. m.	0.01	0.10	0.26	0.53	0.61	0.64									
Peoria, Ill.	22	Midnight	3:15 a. m.	1.61	12:30 a. m.	1:34 a. m.	0.13	0.10	0.25	0.40	0.54	0.69	0.80	0.86	0.92	0.98	1.05	1.23	1.35		
Philadelphia, Pa.	16	5:35 p. m.	7:15 p. m.	2.20	5:52 p. m.	6:23 p. m.	0.09	0.41	0.71	1.08	1.31	1.80	2.07	2.09							
Phoenix, Ariz.	11			0.11														0.10			
Pierre, S. Dak.	13			0.27														0.26			
Pittsburgh, Pa.	21	2:53 p. m.	4:40 p. m.	1.06	2:57 p. m.	3:43 p. m.	0.01	0.24	0.44	0.51	0.57	0.64	0.72	0.81	0.90	1.00	1.02				
Pocatello, Idaho.	3			0.02														0.02			
Point Reyes Light, Cal.	16			T.														T.			
Port Arthur, Tex.	19	4:11 a. m.	8:00 a. m.	2.04	5:13 a. m.	5:36 a. m.	0.33	0.39	0.86	1.22	1.36	1.43									
		12:54 p. m.	2:10 p. m.	1.67	12:58 p. m.	1:26 p. m.	0.01	0.30	0.57	1.02	1.36	1.52	1.59								
	28	8:57 a. m.	10:40 a. m.	1.69	9:15 a. m.	9:45 a. m.	0.01	0.18	0.37	0.79	1.07	1.38	1.56								
Port Huron, Mich.	5	2:15 p. m.	3:08 p. m.	0.83	2:34 p. m.	3:02 p. m.	0.01	0.23	0.38	0.51	0.68	0.79	0.82								
Portland, Me.	17	4:30 a. m.	11:38 a. m.	1.97	8:37 a. m.	9:23 a. m.	0.66	0.05	0.10	0.15	0.25	0.34	0.46	0.59	0.79	0.93	0.95				
Portland, Oreg.	17			T.														T.			
Providence, R. I.	10	D. N. a. m.	9:48 a. m.	2.23	4:15 a. m.	4:35 a. m.	0.16	0.20	0.37	0.45	0.52										
	10	D. N. a. m.	9:48 a. m.	2.23	5:19 a. m.	5:49 a. m.	0.76	0.10	0.20	0.27	0.40	0.47	0.52								
	17	8:50 a. m.	10:52 a. m.	0.83	9:40 a. m.	10:05 a. m.	0.07	0.07	0.20	0.44	0.62	0.69									
	30	6:10 p. m.	10:10 p. m.	1.09	6:31 p. m.	7:01 p. m.	0.02	0.05	0.10	0.13	0.31	0.46	0.60								
Pueblo, Colo.	12			1.26														0.46			
Raleigh, N. C.	8			0.48																	
Rapid City, S. Dak.	5–6	8:50 p. m.	D. N. a. m.	1.04	3:02 a. m.	3:36 a. m.	0.41	0.05	0.19	0.22	0.27	0.41	0.51	0.56							
Reading, Pa.	9	7:14 p. m.	10:40 p. m.	0.67	7:18 p. m.	7:45 p. m.	0.01	0.10	0.26	0.35	0.43	0.50	0.54								
Red Bluff, Cal.	‡			‡																	
Reno, Nev.	25			0.11														0.06			
Richmond, Va.	10	D. N. a. m.	D. N. a. m.	0.67	12:40 a. m.	1:00 a. m.	0.01	0.16	0.40	0.46	0.52										
	16	10:20 p. m.	12:30 a. m.	0.79	10:34 p. m.	10:59 p. m.	0.05	0.05	0.17	0.33	0.45	0.57									
Rochester, N. Y.	14			0.72														0.54			
Roseburg, Oreg.	3			T.														T.			

* Self-register not working. † Record partly estimated. ‡ No precipitation occurred during month.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during August, 1917, at all stations furnished with self-registering gages*—Concluded.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Roswell, N. Mex.	12	2:52 a. m.	4:45 a. m.	0.93	3:20 a. m.	3:56 a. m.	0.06	0.08	0.19	0.26	0.40	0.51	0.61	0.69	0.73	.....	.....	.....	.....	.....	.....
Sacramento, Cal.	25	.....	.....	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.	.....	.....	.....
Saginaw, Mich.	9	.....	.....	0.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.37	.....	.....	.....
St. Joseph, Mo.	6–7	8:38 p. m.	D. N. a. m.	2.36	11:08 p. m.	11:56 p. m.	0.50	0.06	0.21	0.49	0.81	1.05	1.19	1.40	1.52	1.64	1.68	.....	.....	.....	.....
St. Louis, Mo.	5	.....	.....	0.32	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.31	.....	.....	.....
St. Paul, Minn.	7	.....	.....	1.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.47	.....	.....	.....
Salt Lake City, Utah	27	.....	.....	0.26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.24	.....	.....	.....
San Antonio, Tex.	23	.....	.....	0.10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.09	.....	.....	.....
San Diego, Cal.	24	.....	.....	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.	.....	.....	.....
Sand Key, Fla.	27	2:05 a. m.	5:32 a. m.	0.83	4:22 a. m.	4:35 a. m.	0.30	0.22	0.36	0.53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sandusky, Ohio	23	D. N. a. m.	D. N. a. m.	1.50	3:13 a. m.	4:16 a. m.	0.04	0.12	0.15	0.16	0.37	0.60	0.75	0.94	10.5	1.14	1.15	1.33	1.43	.....	.....
Sandy Hook, N. J.	24	.....	.....	1.56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.52	.....	.....	.....
San Francisco, Cal.	16–17	.....	.....	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.	.....	.....	.....
San Jose, Cal.	‡	.....	.....	‡	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Luis Obispo, Cal.	‡	.....	.....	‡	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Santa Fe, N. Mex.	23	.....	.....	0.76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.46	.....	.....	.....
Sault Ste. Marie, Mich.	18	.....	.....	0.27	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.25	.....	.....	.....
Savannah, Ga.	3	3:44 p. m.	9:10 p. m.	4.12	4:33 p. m.	5:46 p. m.	0.04	0.09	0.21	0.40	0.66	1.08	1.55	1.85	2.28	2.65	2.97	3.40	3.82	.....	.....
	17	5:40 p. m.	6:50 p. m.	1.03	5:45 p. m.	6:25 p. m.	0.01	0.18	0.27	0.34	0.41	0.60	0.77	0.87	1.00	.....	.....	.....	.....	.....	.....
	29	12:02 p. m.	1:45 p. m.	0.80	12:35 p. m.	1:13 p. m.	0.10	0.10	0.18	0.30	0.42	0.48	0.52	0.57	0.64	.....	.....	.....	.....	.....	.....
Scranton, Pa.	29	.....	.....	0.64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.61	.....	.....	.....
Seattle, Wash.	6	.....	.....	0.02	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.01	.....	.....	.....
Sheridan, Wyo.	31	.....	.....	0.43	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.13	.....	.....	.....
Shreveport, La.	29	4:15 a. m.	6:25 a. m.	1.62	5:01 a. m.	5:24 a. m.	0.32	0.26	0.54	0.88	1.14	1.20	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sioux City, Iowa	6	12:35 p. m.	7:45 p. m.	1.88	1:51 p. m.	2:33 p. m.	0.14	0.12	0.25	0.34	0.39	0.40	0.46	0.57	0.66	0.70	.....	.....	.....	.....	.....
Spokane, Wash.	9	.....	.....	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.	.....	.....	.....
Springfield, Ill.	28	.....	.....	0.64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.50	.....	.....	.....
Springfield, Mo.	9	D. N. a. m.	D. N. a. m.	0.63	1:54 a. m.	2:10 p. m.	0.01	0.13	0.33	0.47	0.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	20	12:40 p. m.	3:08 p. m.	0.80	12:42 p. m.	1:21 p. m.	0.01	0.33	0.45	0.49	0.51	0.58	0.63	0.69	0.74	.....	.....	.....	.....	.....	.....
Syracuse, N. Y.	22	6:39 p. m.	7:25 p. m.	0.70	6:41 p. m.	6:56 p. m.	T.	0.22	0.51	0.65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tacoma, Wash.	20	.....	.....	0.04	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.02	.....	.....	.....
Tampa, Fla.	11	4:50 p. m.	6:15 p. m.	1.23	4:54 p. m.	5:19 p. m.	0.01	0.18	0.56	0.80	1.01	1.18	.....	.....	.....	.....	.....	.....	.....	.....	.....
	14	4:07 p. m.	9:15 p. m.	2.06	4:19 p. m.	5:37 p. m.	0.01	0.18	0.54	0.83	1.03	1.09	.....	1.12	1.23	1.43	1.53	1.61	1.67	1.88	.....
	18	8:04 a. m.	9:25 a. m.	0.91	8:15 a. m.	8:39 a. m.	0.01	0.10	0.24	0.34	0.62	0.84	.....	.....	.....	.....	.....	.....	.....	.....	.....
	21	D. N. a. m.	D. N. a. m.	1.54	3:37 a. m.	4:29 a. m.	0.07	0.07	0.10	0.15	0.43	0.77	0.84	1.02	1.16	1.26	1.38	1.46	.....	.....	.....
Tatoosh Island, Wash.	19	.....	.....	1.24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.23	.....	.....	.....
Taylor, Tex.	28	.....	.....	0.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.36	.....	.....	.....
Terre Haute, Ind.	7	.....	.....	0.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.49	.....	.....	.....
Thomasville, Ga.	4	D. N. a. m.	7:31 a. m.	1.77	6:28 a. m.	6:48 a. m.	0.97	0.15	0.23	0.46	0.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	4	9:05 a. m.	11:20 a. m.	0.90	9:48 a. m.	10:00 a. m.	0.09	0.19	0.55	0.59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	16	3:40 p. m.	7:03 p. m.	0.79	5:47 p. m.	6:06 p. m.	0.01	0.29	0.47	0.55	0.70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	30	12:10 p. m.	1:30 p. m.	1.09	12:23 p. m.	12:49 p. m.	0.02	0.16	0.28	0.43	0.79	1.05	1.07	.....	.....	.....	.....	.....	.....	.....	.....
Toledo, Ohio	22	.....	.....	0.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.20	.....	.....	.....
Tonopah, Nev.	12	.....	.....	0.32	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.32	.....	.....	.....
Topeka, Kans.	6	D. N. p. m.	D. N. p. m.	1.18	10:35 p. m.	11:07 p. m.	0.06	0.17	0.23	0.35	0.43	0.64	0.97	1.08	.....	.....	.....	.....	.....	.....	.....
	8	9:04 p. m.	10.10 p. m.	0.69	9:23 p. m.	9:37 p. m.	0.02	0.14	0.52	0.65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Trenton, N. J.	16	5:16 p. m.	6:20 p. m.	0.94	5:24 p. m.	5:47 p. m.	0.01	0.15	0.40	0.79	0.83	0.92	.....	.....	.....	.....	.....	.....	.....	.....	.....
Valentine, Nebr.	6	.....	.....	0.46	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.27	.....	.....	.....
Vicksburg, Miss.	16	4:20 p. m.	5:20 p. m.	0.70	4:23 p. m.	4:34 p. m.	0.01	0.15	0.59	0.63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Walla Walla, Wash.	3	.....	.....	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.	.....	.....	.....
Washington, D. C.	9	.....	.....	0.52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.22	.....	.....	.....
Wichita, Kans.	6–7	8:50 p. m.	D. N. a. m.	1.21	9:25 p. m.	9:57 p. m.	0.12	0.09	0.19	0.34	0.52	0.78	1.05	1.09	.....	.....	.....	.....	.....	.....	.....
Williston, N. Dak.	4	.....	.....	0.12	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.05	.....	.....	.....
Wilmington, N. C.	29	D. N. a. m.	D. N. a. m.	0.58	1:10 a. m.	1:30 a. m.	0.01	0.21	0.35	0.43	0.55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	30	1:05 p. m.	1:40 p. m.	0.53	1:08 p. m.	1:27 p. m.	0.02	0.06	0.11	0.35	0.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Winnemucca, Nev.	26	.....	.....	0.48	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.30	.....	.....	.....
Wytheville, Va.	15	.....	.....	0.63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.47	.....	.....	.....
Yankton, S. Dak.	2	.....	.....	0.96	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.67	.....	.....	.....
Yellowstone Park, Wyo.	3	.....	.....	0 08	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.05	.....	.....	.....

* Self-register not working. † Record partly estimated. ‡ No precipitation occurred during month.

TABLE III.—*Data furnished by the Canadian Meteorological Service, August, 1917.*

Stations.	Altitude above M. S. L.* Jan. 1, 1916.	Pressure.			Temperature.						Precipitation.		
		Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+ mean min.÷2.	Departure from normal.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Total.	Departure from normal.	Total snowfall.
	Feet.	*Inches.*	*Inches.*	*Inches.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*Inches.*	*Inches.*	*Inches.*
St. Johns, N. F.	125	29.92	30.05	+0.09	65.2	+5.4	73.7	56.8	83	44	2.22	−1.86	.....
Sydney, C. B. I.	48	30.04	30.08	+ .13	66.0	+2.7	75.3	56.7	90	46	3.36	−0.26	.....
Halifax, N. S.	88	29.96	30.06	+ .10	67.0	+3.4	74.8	59.1	86	50	4.78	+0.43	.....
Yarmouth, N. S.	65	29.96	30.03	+ .06	63.7	+3.5	71.5	56.0	80	48	2.11	−1.90	.....
Charlottetown, P. E. I.	38	29.98	30.02	+ .08	68.3	+4.0	74.8	61.7	81	49	4.85	+1.11	.....
Chatham, N. B.	28	29.99	30.01	+0.08	68.0	+4.8	77.2	58.7	96	45	6.90	+2.86	.....
Father Point, Que.	20	29.93	29.95	+ .04	59.7	+4.1	68.5	51.0	83	40	3.84	+0.79	.....
Quebec, Que.	296	29.67	29.99	+ .06	66.4	+3.3	74.2	58.6	91	45	6.07	+2.24	.....
Montreal, Que.	187	29.78	29.98	+ .03	68.0	+1.6	76.0	60.1	96	50	7.03	+3.46	.....
Stonecliffe, Ont.	489	29.35	29.95	− .01	66.2	+3.0	75.7	56.7	92	44	1.78	−1.17	.....
Ottawa, Ont.	236	29.71	29.97	+0.01	67.8	+3.0	78.5	57.1	97	46	4.03	+1.00	.....
Kingston, Ont.	285	29.68	29.98	± .00	69.1	+2.1	77.4	60.8	87	52	3.37	+0.99	.....
Toronto, Ont.	379	29.58	29.97	− .02	67.7	+1.7	77.7	57.7	92	46	4.44	+1.68	.....
White River, Ont.	1,244	28.62	29.93	− .03	53.8	−2.6	67.1	40.6	80	27	4.62	+1.32	.....
Port Stanley, Ont.	592	29.38	30.01	+ .01	65.5	−0.4	74.8	56.2	85	46	1.84	−0.58	.....
Southampton, Ont.	656	29.29	.....	.....	64.3	+0.5	72.6	56.0	88	42	3.28	+1.03	.....
Parry Sound, Ont.	688	29.29	29.97	−0.01	65.1	+1.6	74.4	55.8	92	42	4.15	+1.43	.....
Port Arthur, Ont.	644	29.23	29.94	− .02	59.0	−0.5	70.0	48.0	82	34	2.22	−0.53	.....
Winnipeg, Man.	760	29.09	29.91	− .03	63.3	−0.1	75.0	51.6	89	39	1.70	−0.97	.....
Minnedosa, Man.	1,690	28.15	29.93	+ .01	62.3	−2.9	76.6	48.1	93	33	1.22	−0.88	.....
Qu'Appelle, Sask.	2,115	27.72	29.94	+0.01	61.4	−0.1	75.2	47.5	88	35	2.61	+0.97	.....
Medicine Hat, Alberta.	2,144	27.70	29.94	+ .02	66.8	+1.1	83.7	50.0	95	38	0.77	−0.90	.....
Swift Current, Sask.	2,392	27.42	29.95	+ .02	62.9	−1.1	79.4	46.3	93	36	1.26	−0.65	.....
Calgary, Alberta.	3,428	26.53	30.02	+ .11	60.4	+1.0	77.3	43.5	88	34	1.52	−0.62	.....
Banff, Alberta.	4,521	25.49	30.01	+ .10	56.4	+0.1	72.7	40.1	84	30	1.87	−0.66	.....
Edmonton, Alberta.	2,150	27.71	29.95	+0.03	58.9	+0.1	70.6	47.3	80	35	2.77	+0.64	.....
Prince Albert, Sask.	1,450	28.41	29.94	+ .02	61.4	+2.5	74.9	48.0	90	40	1.51	−0.64	.....
Battleford, Sask.	1,592	28.24	29.96	+ .05	62.0	−0.6	76.3	47.7	90	36	1.88	−0.48	.....
Kamloops, B. C.	1,262	28.78	30.05	+ .14	69.7	+1.1	84.3	55.0	95	46	1.18	+0.09	.....
Victoria, B. C.	230	29.83	30.08	+ .07	60.4	+1.7	69.2	51.6	82	49	0.19	−0.41	.....
Barkerville, B. C.	4,180	25.84	30.14	+0.24	51.6	−4.7	61.8	41.4	72	34	2.17	−0.93	.....
Hamilton, Bermuda.	151	29.98	30.14	+ .04	79.2	−0.4	84.2	74.3	86	71	4.82	−1.26	.....
LATE REPORT—JULY, 1917.													
Edmonton, Alberta	2,150	27.56	29.79	−0.11	63.3	+2.7	77.3	49.3	86	40	3.15	+0.12	.....

* *See* Explanation of tables in this REVIEW for July, 1917, p. 388.

Chart I. Hydrographs of Several Principal Rivers, August, 1917.

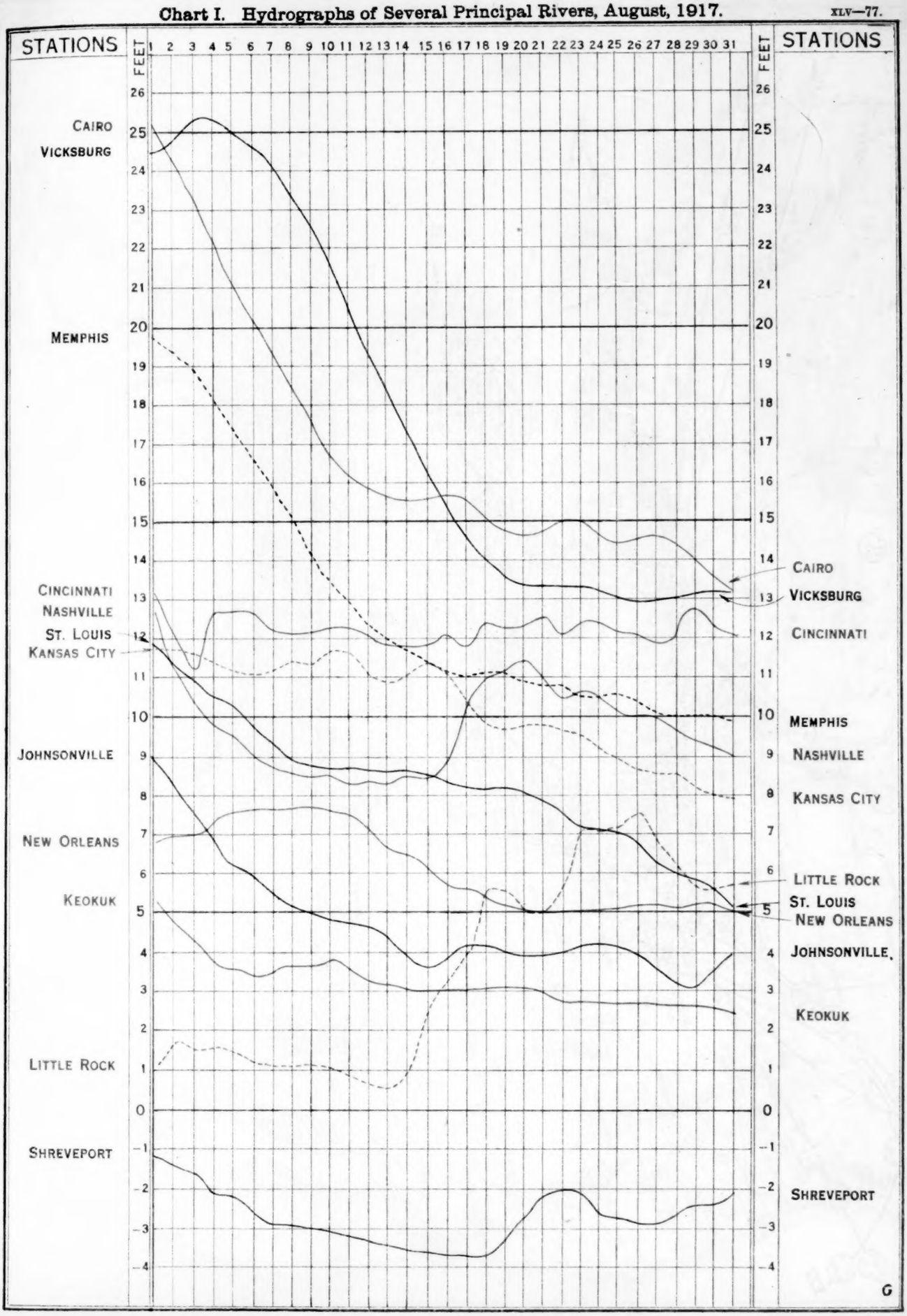


Chart II. Tracks of Centers of High Areas, August, 1917.

(Plotted by Charles A. Donnel.)

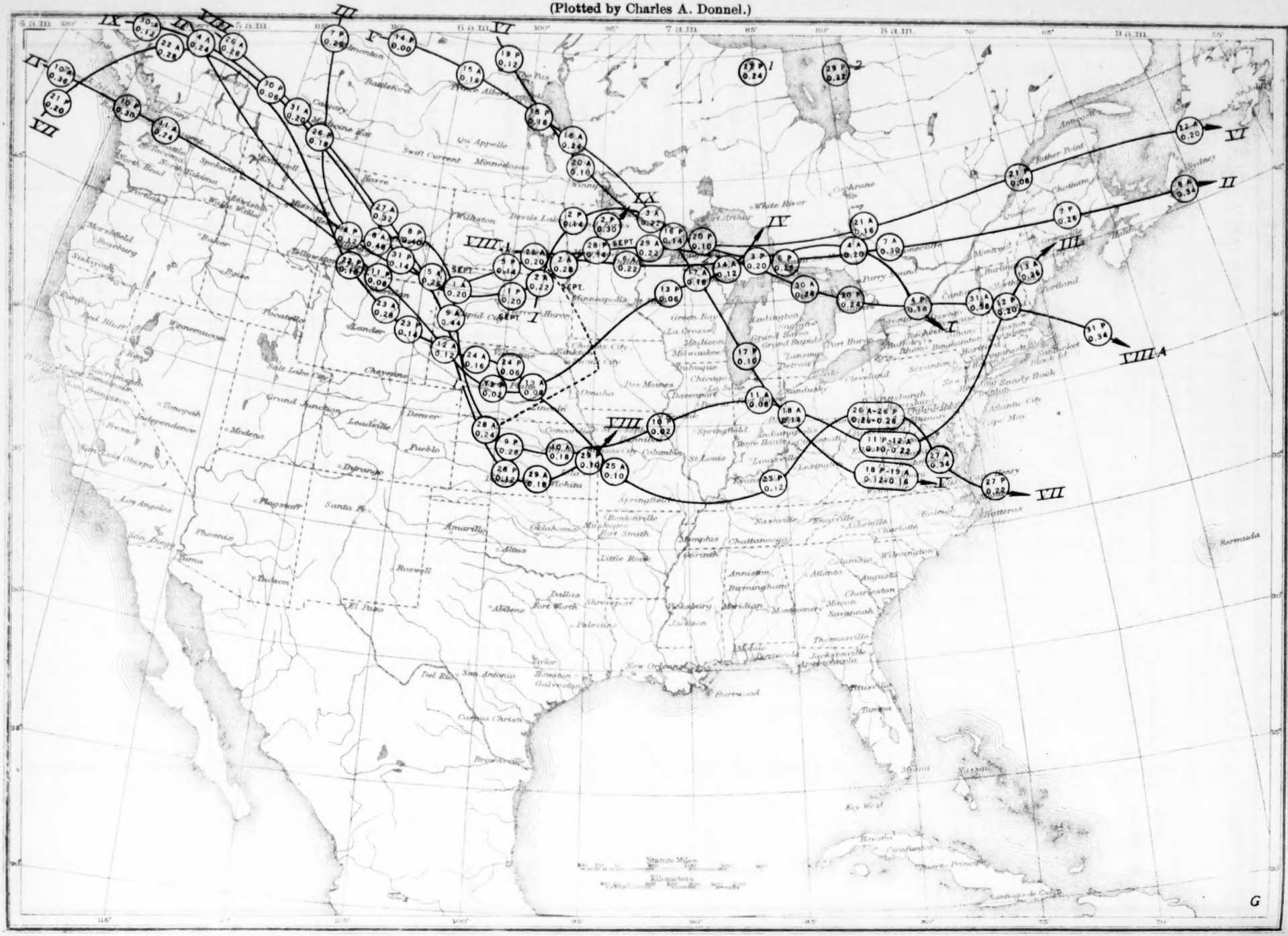


Chart III. Tracks of Centers of Low Areas, August, 1917.

(Plotted by Charles A. Donnel.)

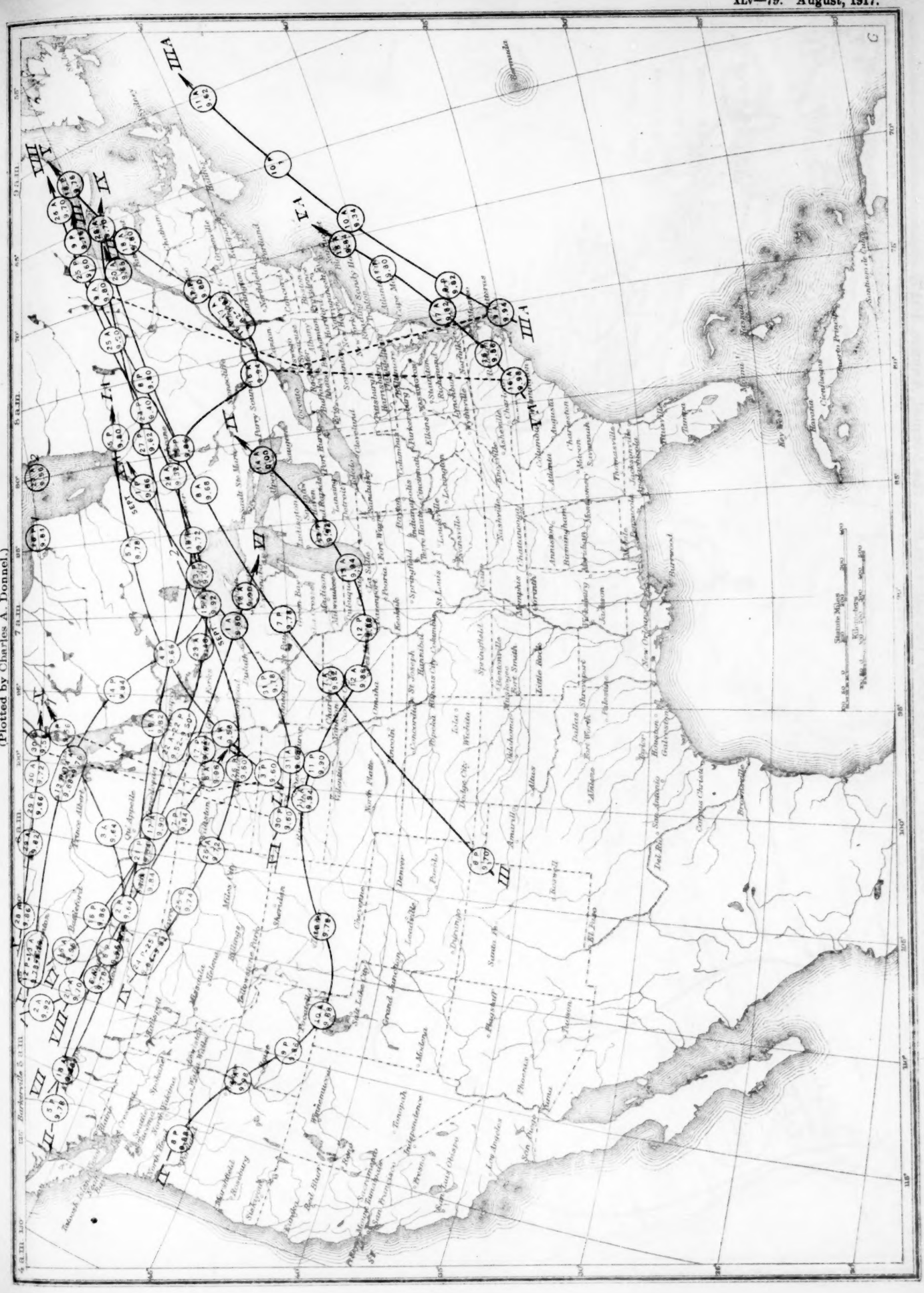


Chart III. Tracks of Centers of Low Areas, August, 1917.
(Plotted by Charles A. Donnel.)

Chart IV. Departure (°F.) of the Mean Temperature from the Normal, August, 1917.

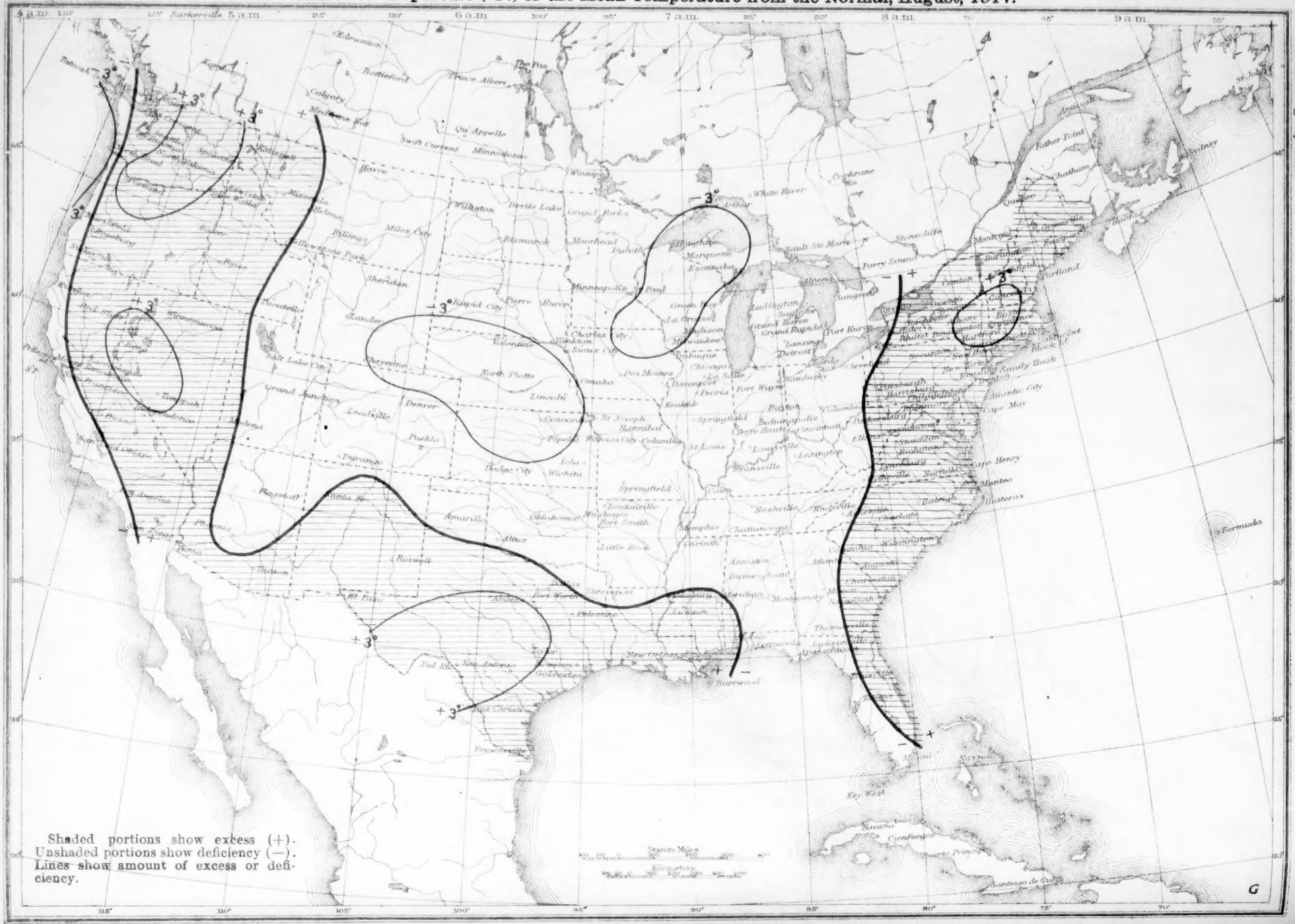


Chart V. Total Precipitation, August, 1917.

Chart V. Total Precipitation, August, 1917.

Chart VI. Percentage of Clear Sky between Sunrise and Sunset, August, 1917.

Chart VII. Isobars and Isotherms at Sea Level; Prevailing Winds, August, 1917.

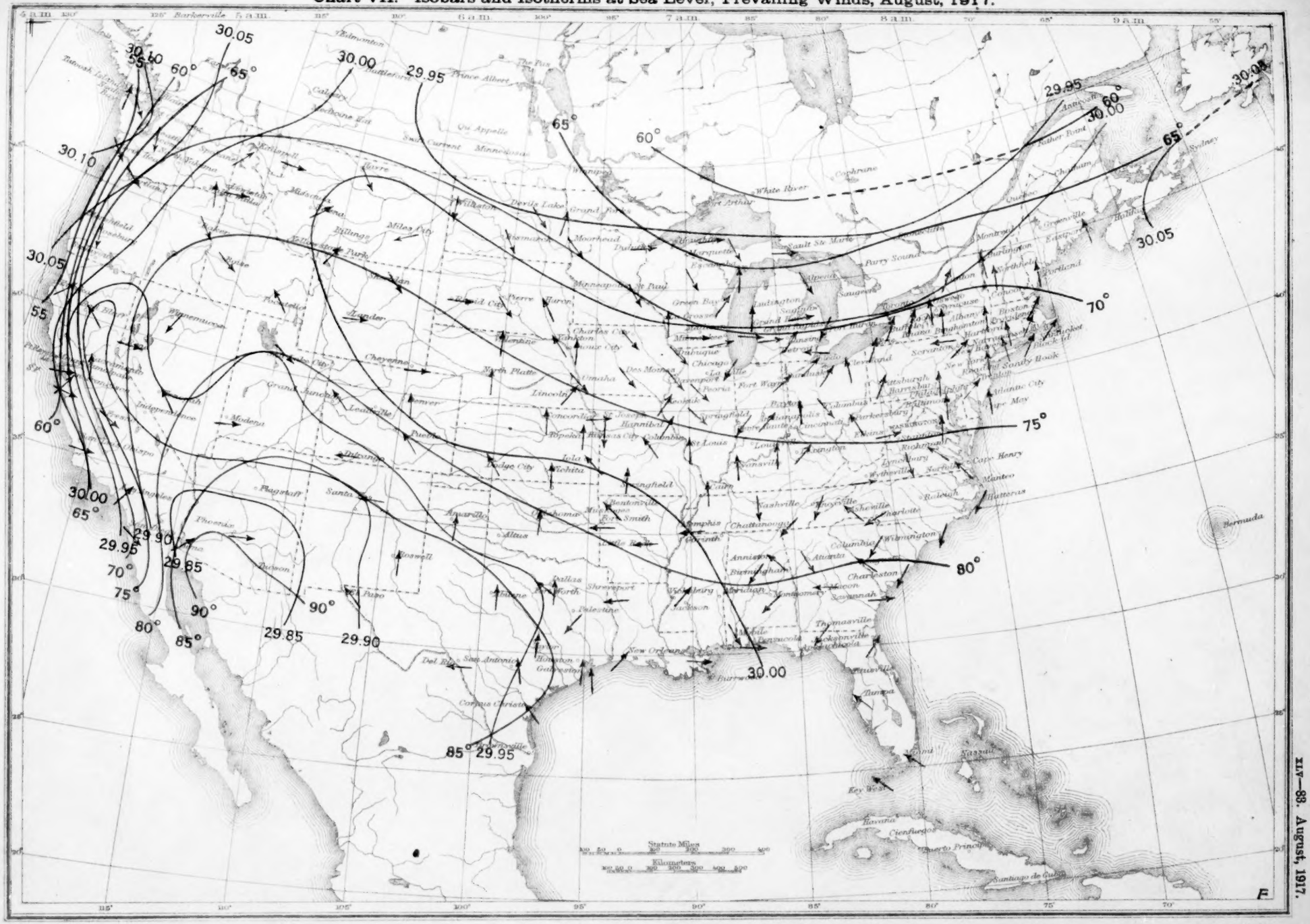
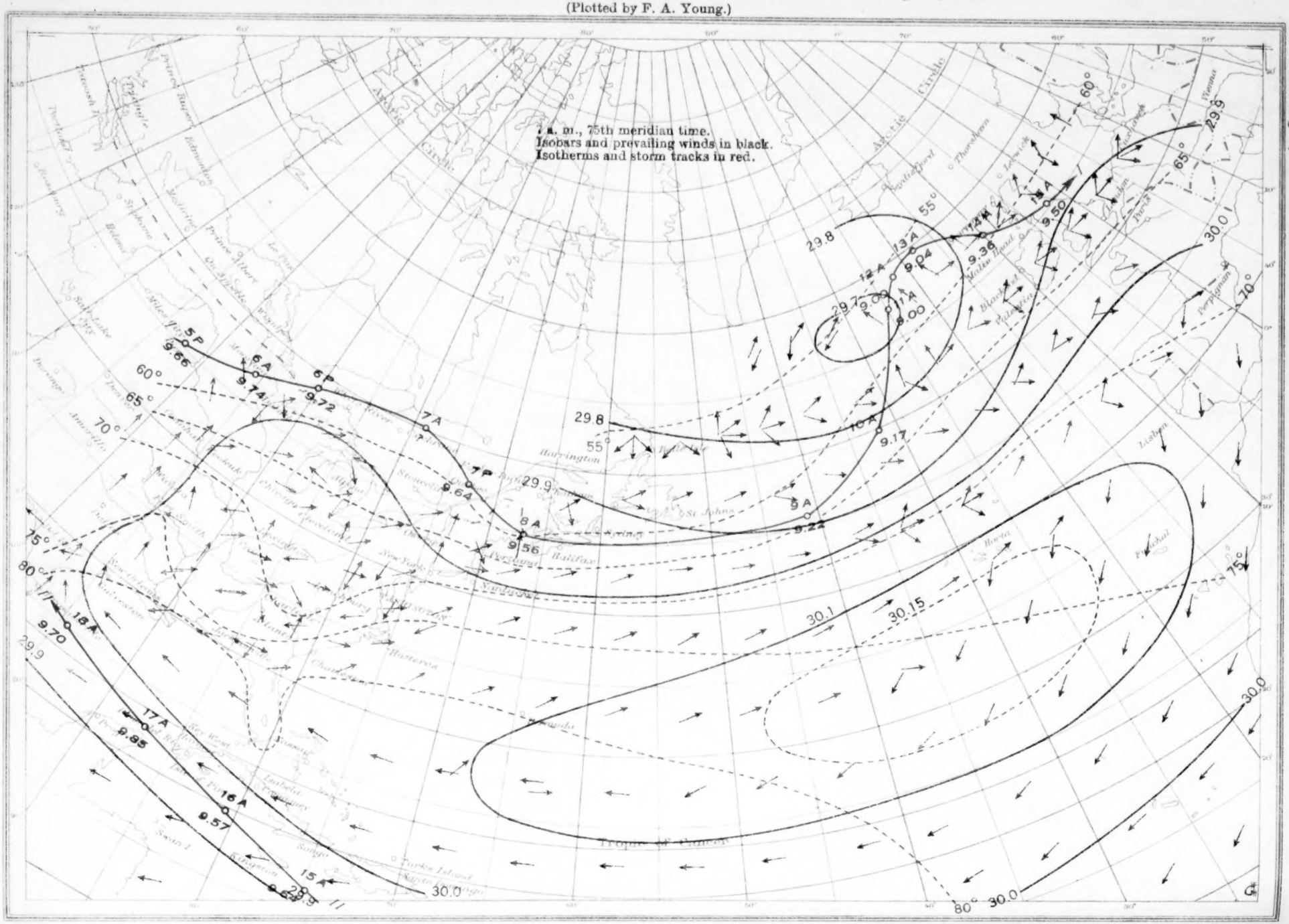
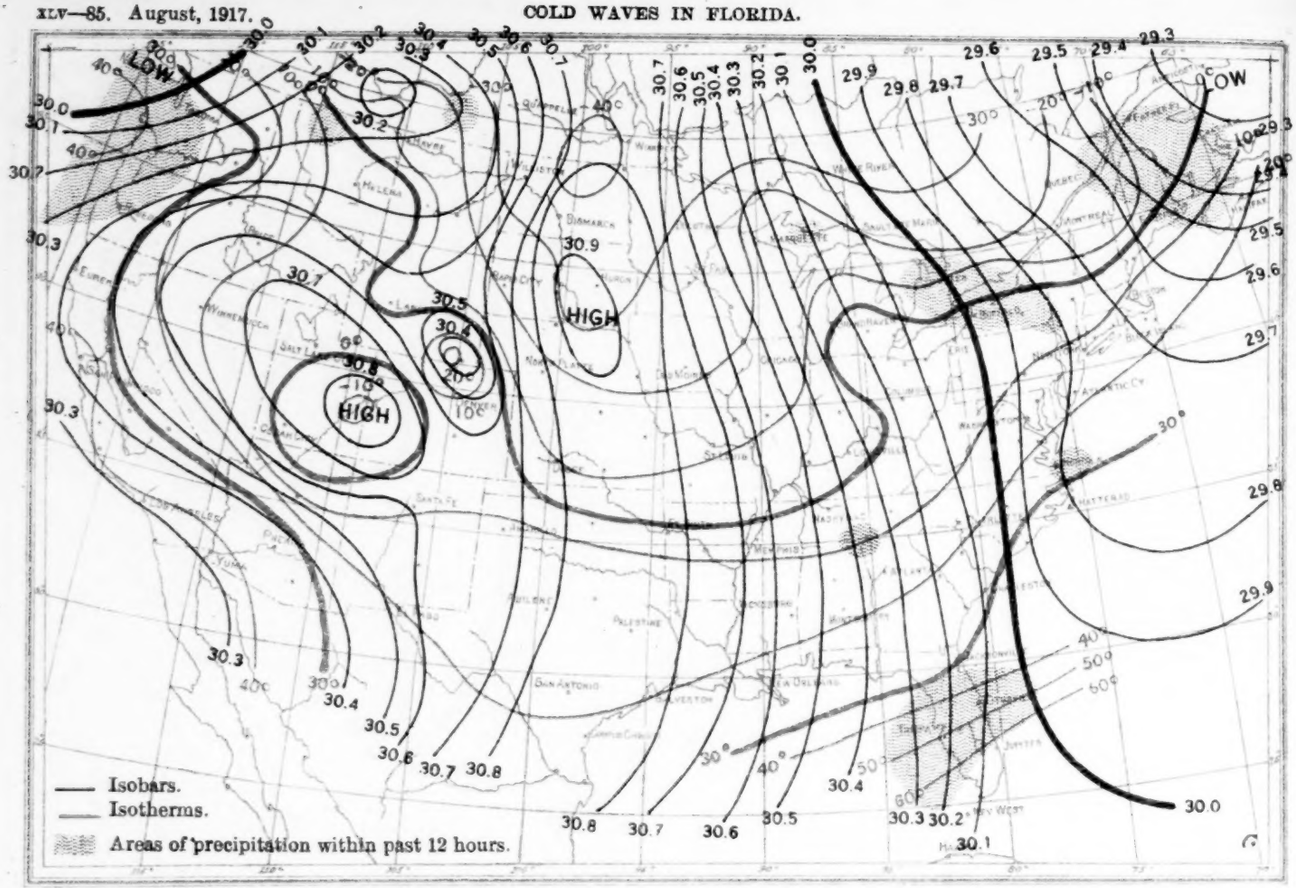


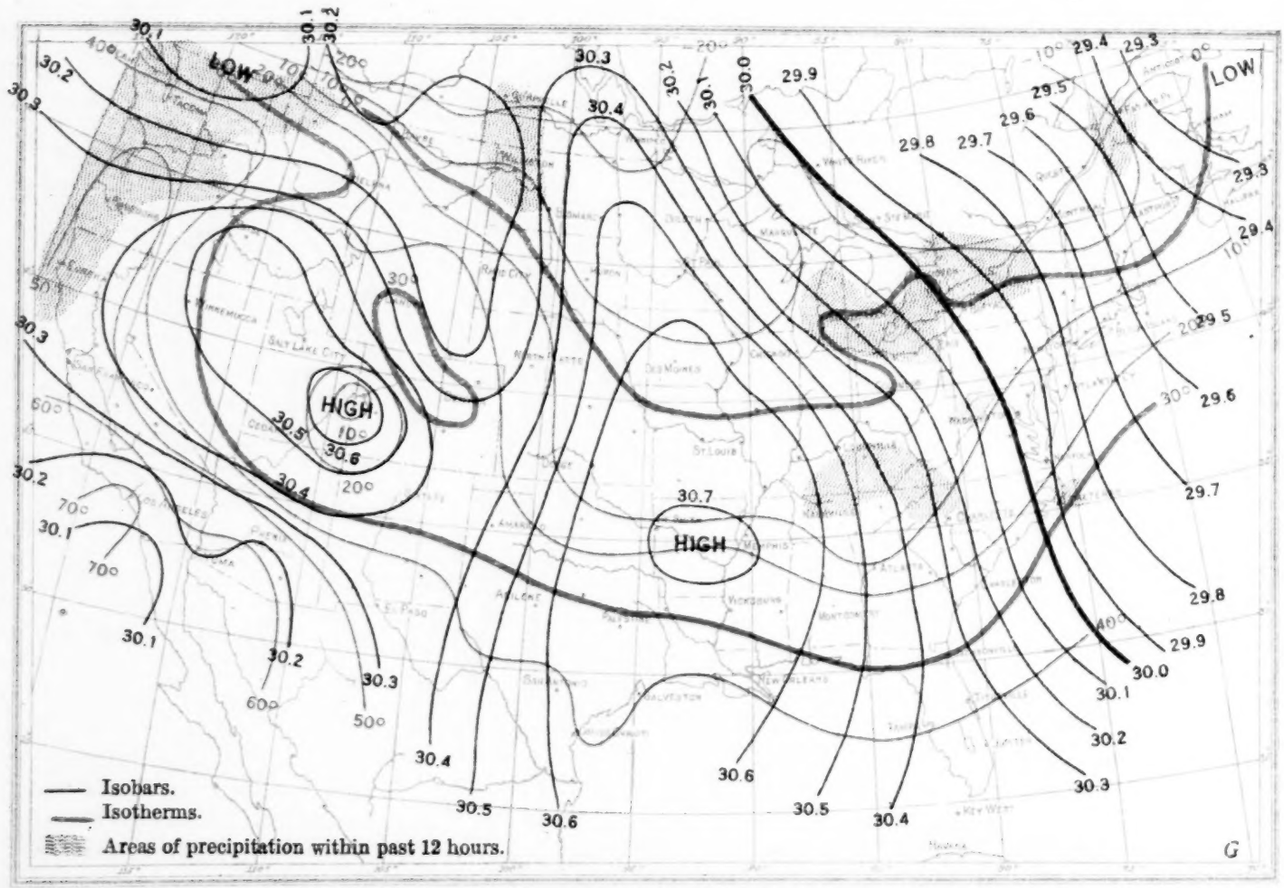
Chart IX. Means of Meteorological Data for North Atlantic Ocean, August, 1916.

(Plotted by F. A. Young.)

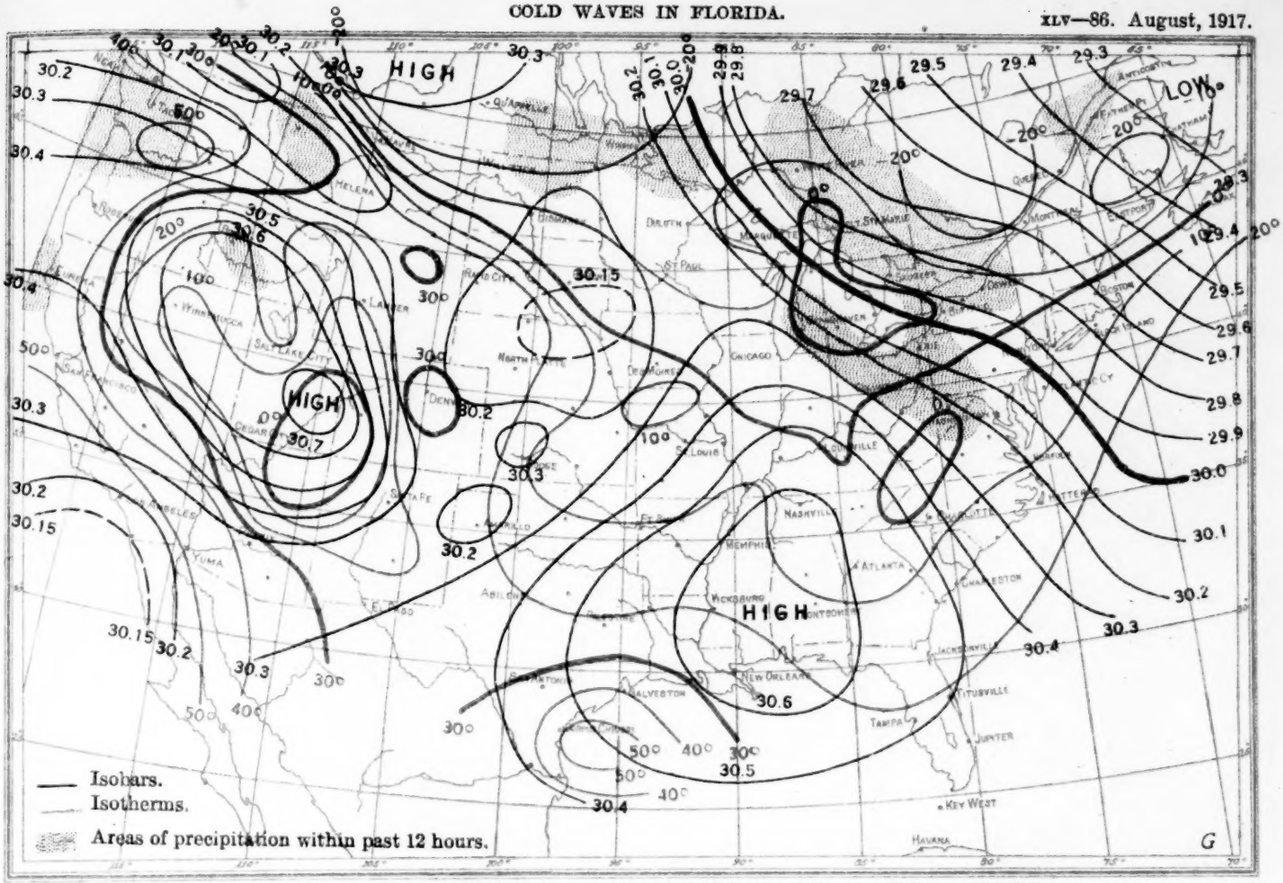




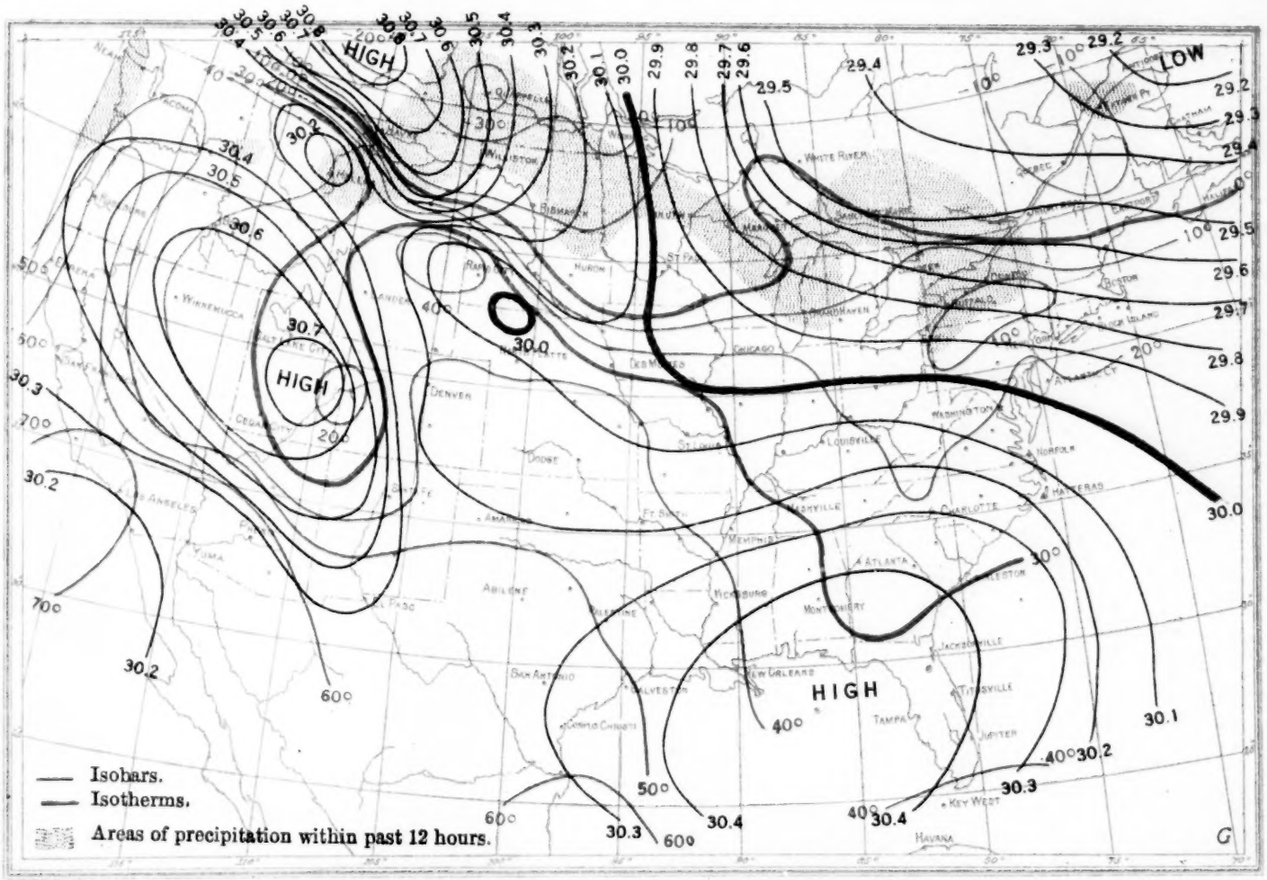
A. J. M. FIG. 1.—Weather Map for the United States at 8 a. m., February 2, 1917.



A. J. M. FIG. 2.—Weather Map for the United States at 8 p. m., February 2, 1917.



A. J. M. FIG. 3.—Weather Map for the United States at 8 a. m., February 3, 1917.



A. J. M. FIG. 4.—Weather Map for the United States at 8 p. m., February 3, 1917.